DEVELOPMENT WORKSHOP
Human Settlements and Development

CP 3360 · Luanda · ANGOLA
Rua Rei Katyavala 113 · Luanda
Tel : (244 2) 44 83 66 / 71 / 77 Fax : 44 94 94
Email: dwang@angonet.org
www.dw.angonet.org

THE INFORMAL PERI-URBAN WATER SECTOR IN LUANDA

Submitted by
Development Workshop

To

IDRC

June 2009

CONTENTS

1 Background

In 1995 Development Workshop undertook a study of the informal water market in Luanda from the point of view of consumers. It looked at how people who do not have a consistent connection to potable water from the underground pipeline (the majority of the population) obtain water. The 1995 study looked into various aspects of the informal water market including the trucks who transport the water, the people who sell the water, and the clients themselves. A further study was carried out in 1998. These studies are now over a decade old and do not take into account the significant urban growth (population size, density, and in occupied territory) that has occurred since, or possible changes in the informal water market that may have occurred for other reasons.

Furthermore, peace has been achieved in Angola since 2002 and one of the important challenges of post-war reconstruction is to provide more and better quality basic services, such as water. The Angolan Government has incorporated the Millennium Development Goal of halving the number of people lacking minimal access to potable water by 2015. In the present context of post-war reconstruction there are large-scale plans (both Government of Angola and bi-lateral and multi-lateral donors) for increasing water-supply to Luanda and other cities, through increased pumping and pipeline capacity. It is, however, likely that the majority of Angola's peri-urban population will continue to rely for its water supplies on the informal market, such as by purchase of water from owners of tanks who have bought their water from lorry-owners who transport water from the nearest river.

It is therefore useful to study the informal water sector in Luanda in the post-war context, to understand how it has adapted to the growing size of the city and to the post-conflict context. There is a need to know more about the informal supply of water and how it has evolved since Development Workshop's research in the 1990s. It is also important to understand better how it is likely to evolve and react to improved formal, regular water supply systems. Finally, there is a need to understand better how institutional capacity can best be developed, especially at the interface between Water Companies and community management.

Previous attempts to improve peri-urban water supply have been hampered by the government's lack of capacity to maintain the infrastructure that already exists, much less upgrade these systems or build and manage new ones. A vital input to this institutional development for managing and maintaining water supply is better knowledge of the existing (mainly informal) systems and institutions for supplying water. These are likely to continue for some time to come. They may help in developing formal water supply or they may hinder it. There may be important lessons of how to create systems using non-conventional opportunities and institutions for community enterprise and management of this natural resource.

2 Objectives

This report is of a study of the informal water sector in Luanda in the post-war context. The research was an applied research project with a view to advocacy for improved Government water policy and practice so as to bring it more into line with the needs of poor consumers who fall outside the formal distribution network. The results of the research will inform programme planning and impact assessments for basic services and public health projects of the World Bank, European Union and the Luanda urban Poverty Programme (LUPP).

The research aimed to understand the post-war evolution of the informal water economy (and how it has evolved since Development Workshop research in the 1990s), understand how it is likely to evolve and contribute to the improvement of the supply of water to communities in informal settlements, understand better how institutional capacity can best be developed (especially at the interface between communities and the service providers) and provide lessons about the sector to promote pro-poor poverty reduction strategies through better services.

The research had four objectives:

a) To understand the post-war evolution of the informal water economy and how it has evolved since earlier Development Workshop research in the 1990s;
b) Understand better how the informal water economy is likely to evolve and contribute to the improvement of the supply of water to communities in informal settlements;
c) Understand better how institutional capacity can best be developed, especially at the interface between communities and the service providers.
d) Provide lessons and understanding of the sector that can feed policy advocacy and promote pro-poor poverty reduction strategies through acquisition of better services.

The research will address the key questions below:

- How is the informal water economy changing in the post-conflict period?
- How valid still are conclusions from studies done pre-2002 (especially in 1995 and 1998 for the World Bank by Development Workshop)?
- How does the informal water economy work? Who are the key actors? What are their relationships?
- What is the relationship between formal and informal systems and institutions?
- What is the relationship between community water management and the private informal water supply institutions?
- What are the rules in informal water supply? What are the informal institutions that manage the rules, and the power relationships? Where is value-added? Where are profits made?
- Community attitudes towards the various actors and institutions.
- How does the price for water vary across the city? Factors that affect water prices?
- How can institutional capacity best be developed, especially at the interface between Water Companies and community management taking into consideration the existence of an informal water supply system?

3 Methods

A sample survey was carried out of 1300 households in peri-urban Luanda, covering households characteristics, methods of access to water, water use and consumption strategies. In addition, a sample survey was carried out of 369 households which sell water from household water tanks, and sample survey carried out with 211 drivers of tanker-lorries. A sample survey was also carried out to obtain additional data about the price of water and how it varies across the city.

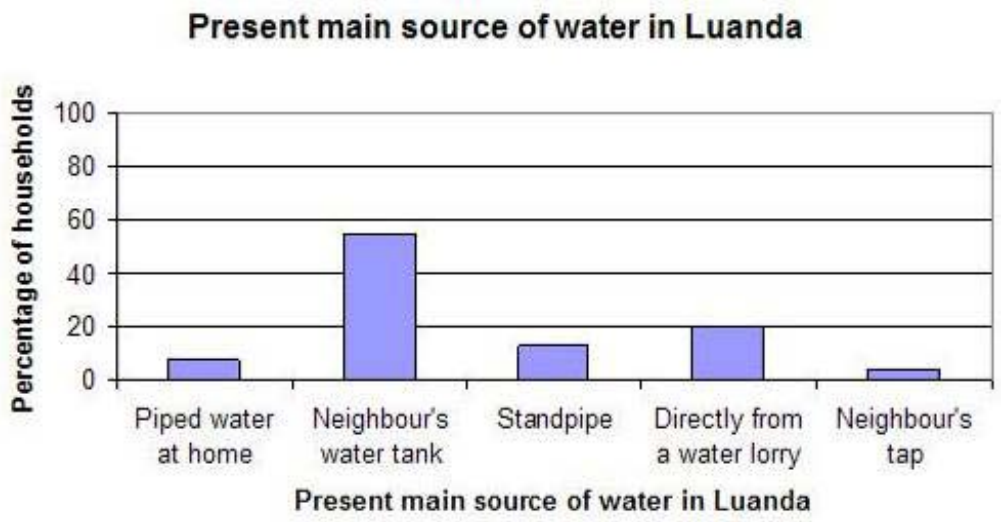
Information about the supply chain and its component parts was obtained by observation and by interviews with institutions and actors in the supply chain. Tanker-lorries were observed and counted when they filled up. Some elements of Value Chain Analysis were used to follow the product (water) through the supply chain. This involved identifying the chain of economic actors who own the product as it moves from primary producers to consumers, the business environment (the infrastructure and policies, institutions and processes that shape the market system) and the service providers (the business and extension services that support the market-chain's operation).

4 Main sources of water in peri-urban Luanda

4.1 Sources

4.1.1 Main present water sources

The overall quantity of water supplied to Luanda by the formal system has increased since the 1990s. In 1995 EPAL supplied 40,000 cubic metres each day to the city of Luanda from the Kifangondo pumping station (Development Workshop, 1995: footnote 2). The theoretical capacity of the Luanda water system is now 462,000 cubic metres per day and the average real production 274,000 cubic metres per day. Losses in the system are however estimated to be 82,000 cubic metres per day so the amount available is on average 192,000 cubic metres per day (Muller, Figueiredo and Santos, 2008)[1].There is no clear information available about how losses occur. As the piped water system is old, it is likely that they are partly due to leaks from corroded pipes. Some may however be due to unauthorised removal of water from the system.



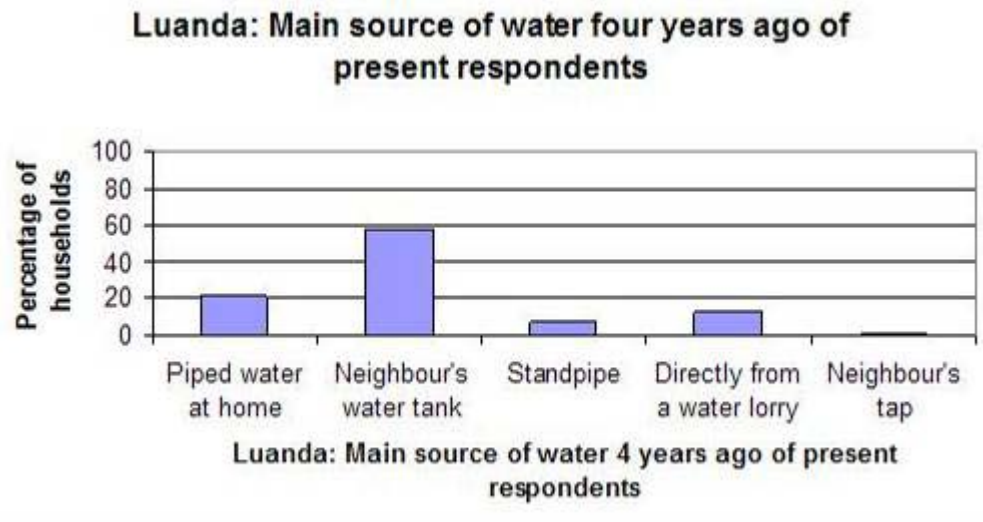
Despite this significant increase, the mostly frequently mentioned source of water in peri-urban Luanda[2] is a neighbour's water tank (55%) and the next most frequently mentioned is directly from a water lorry (20%). The other sources of household water are standpipes (13%) and domestic connections (12%) though this may involve purchase from another person's tap.

4.1.2 Comparison with four years ago

Respondents were also asked what their main source of water was four years ago. A lower proportion of households reported having piped water as their main source of water in 2006 than in 2002, while the number of households obtaining water from standpipes and directly from water lorries increased from 2002 to 2006. There have been a number of small water projects providing water through standpipes between 2002 and 2006, but households have moved from areas of the city with piped water to areas without piped water during this same period. Increased supply of water through the formal system has not kept pace with the growth of the area and population of the city. In 1995 the estimated population of the city of Luanda was 2.1 million. It is now estimated that there almost 6 million people in Luanda and the area of the city has expanded significantly[3]. More water is supplied from Kikuxi (near Viana) to Luanda than in the 1990s, improving somewhat supply to the south and east of Luanda, but much of these newly settled areas to the south and east do not have access to piped water. Overall the

[1] The Commercial Director of EPAL confirmed in a interview in September 2008 that daily production was slightly under 300,000 cubic metres per day.
[2] Data from the household carried out by Development Workshop
[3] This suggests a growth rate of 7.5 per cent per annum.

reliance on informal sources of water continues to be high, with more than half of households obtaining their water from the tank of a neighbour and another 20% obtaining water directly from a water lorry.

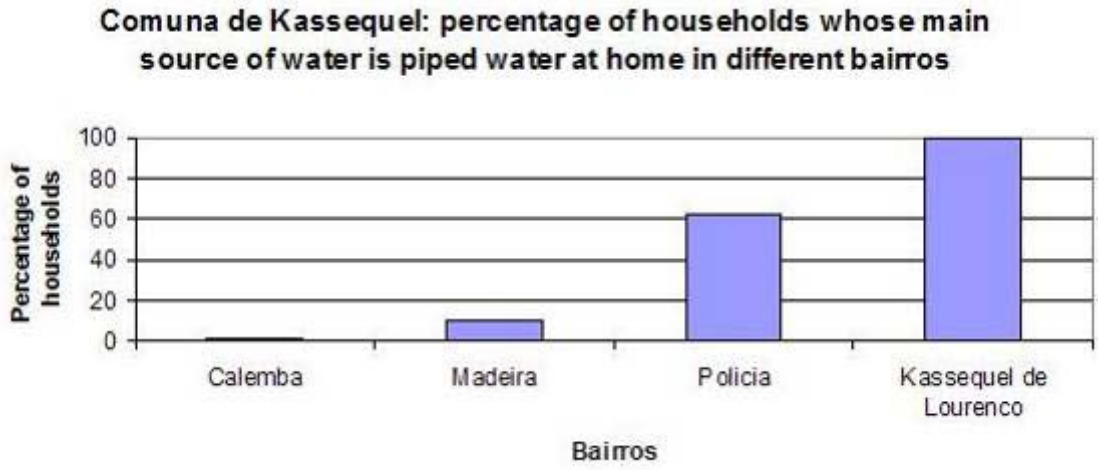


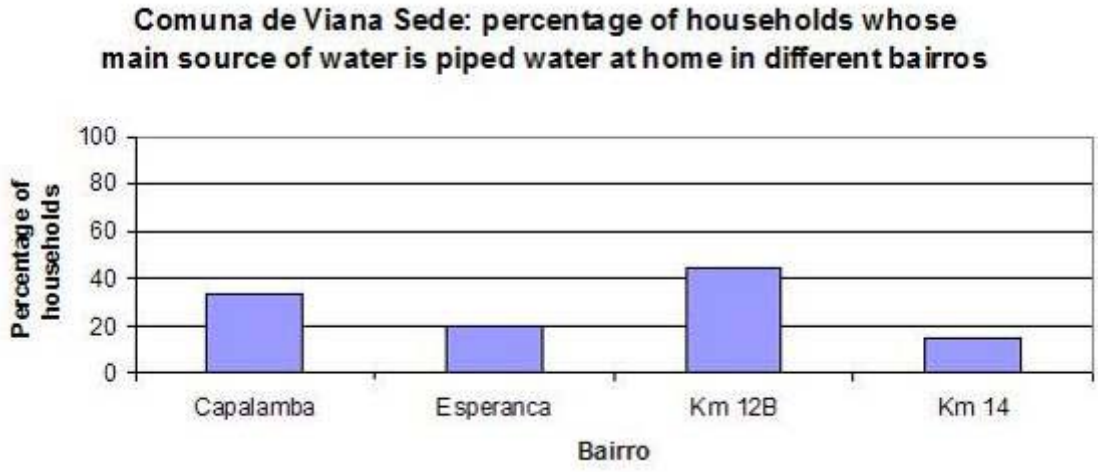
Luanda: Main source of water 4 years ago of present respondents

4.1.3 Geographical differences in water source

There are significant differences between different areas of the city in the way in which water is obtained, and areas to south and east of the city (which are more recent) are more dependent on the informal sector for water supply. However there are no areas of the city where the informal water sector is completely absent. The maps in the following sections show the proportion of households using different water sources in different areas.

There are also differences between bairros in the same comuna: new bairros develop around previously settled areas that have piped water (or standpipes) without being able to access piped water. Projects to supply piped water or standpipes have sometimes only been able to serve limited areas (due to limited pressure, surface features that inhibit expansion of the piped network, or lack of funds). Thus in the Comuna Patrice Lumumba the percentage of households which obtain water from a neighbour's tank or a water lorry in the bairro of Boa Vista is 72% but only 20% in the neighbouring bairro of Bungo. The two charts show the difference in the level of access to piped water at home in two Comunas, Kassequel and Viana Sede.





4.2 Piped water

Diagram A is a schematic representation of water supply to the city of Luanda with rough estimates of the quantities of water involved. EPAL has two pumping stations on the River Bengo at Kifangondo, and each pumping station feeds a separate pipeline to the city. There is also a pumping station at Kikuxi on the River Kwanza. The location of these pumping stations and the main pipelines are shown on the map.

EPAL water distribution in 2006

Water produced	100,000,000 cubic metres per year
Losses	30,000,000 cubic metres per year
Water distributed	70,000,000 cubic metres per year
Water for which invoices issued	40,000,000 cubic metres per year
Water paid for	19,000,000 cubic metres per year

Source: Muller, Figueiredo and Santos, 2008

The distribution stations supply industrial connections, domestic connections and *girafas*[4] (which supply the informal sector). The informal sector is also supplied through connections from domestic connections to domestic water tanks where water is re-sold. There are also significant losses in the system, due to the age of the system and possibly due to aunaithorised connections

[4] *Girafas* means (in Portuguese) giraffes. They are supply points for water lorries that look like giraffe necks.

EPAL *(Empresa Pública da Água,* Luanda) is responsible for maintaining and expanding the pipelines as well as monitoring the quality and quantity of water reaching Luanda's population.

The Angolan Government is responsible for providing legislation and subsidies for the development and maintenance of the water pipelines. Law nº 6/02, commonly known as the Water Law, was issued by the National Assembly in June of 2002. This law dealt with issues affecting water in all of Angola; however, the government has not created any concrete regulations or changes in the law's wake regarding the reality of water in Luanda.

Diagram B shows the chains by which water is supplied to domestic consumers. These chains often include both the formal and the informal sectors.

EPAL does not issue bills for 56% of the water that it produces and does not actively enforce payment of the bills that it does issue, so it collects payment for just under half of the water for which it issues bills. EPAL states that this is because it recognizes that the service is poor and so is reluctant to enforce payment. However the implication of this is that EPAL is only receiving payment for less than 20% of the water that it produces (taking into account losses in the system, non-billing and non-payment) so income for maintenance and expansion of the system is limited and improvements and extensions depend on the state investment budget (which in turn depends on continued high oil prices). The other implication is that the price of water for some people with piped water is zero though they have better access to water than those who are paying significantly more for water from the informal sector (as will be discussed later).

According to an official agreement between the Angolan Ministry of Energy and Water and the Ministry of Finances[5] in 2004 the official price of EPAL water is set at is Kwz 67.5 per m^3.

[5] Despacho Conjunto Number 105/04 (4-5-04)

Diagram A The formal water supply system

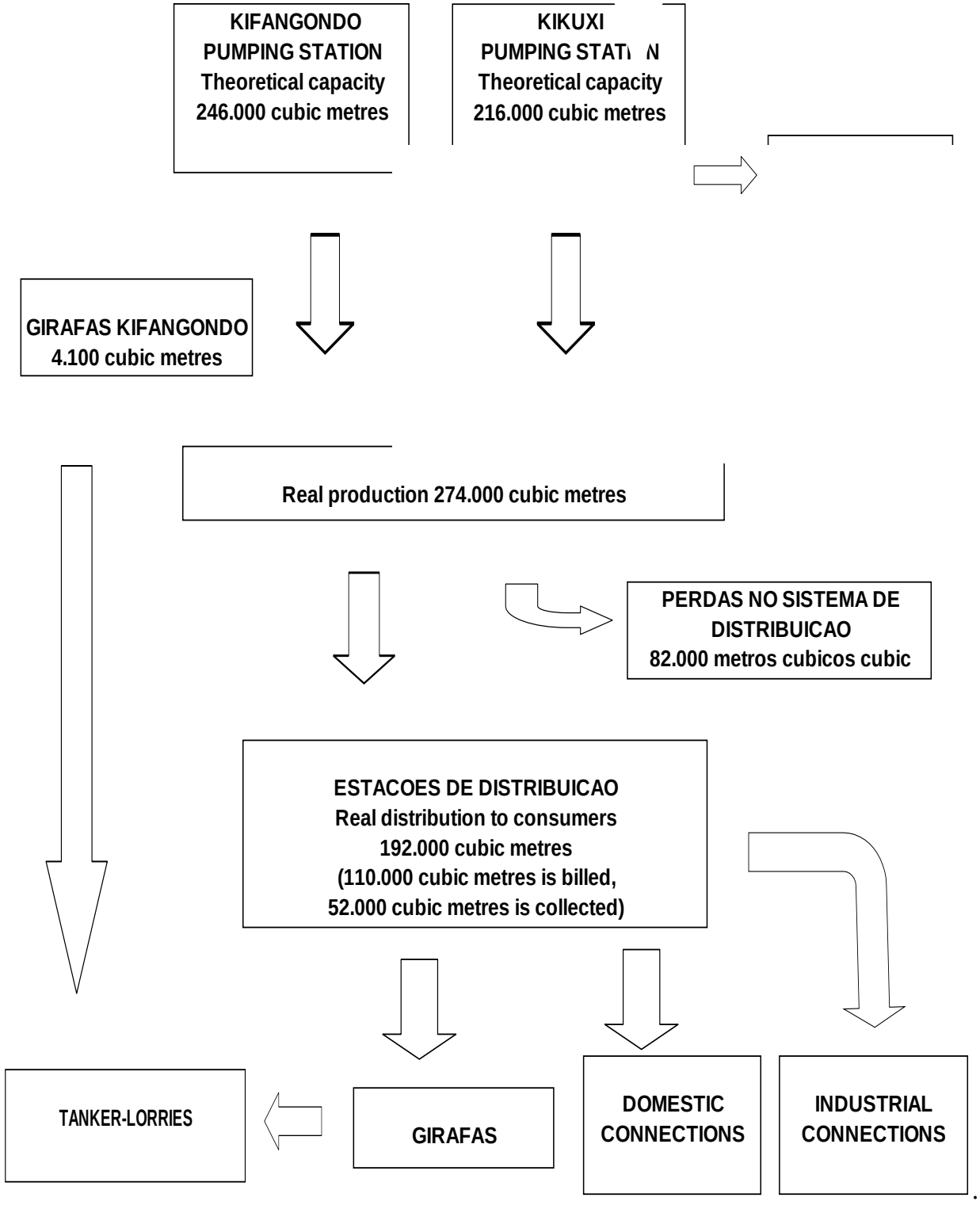
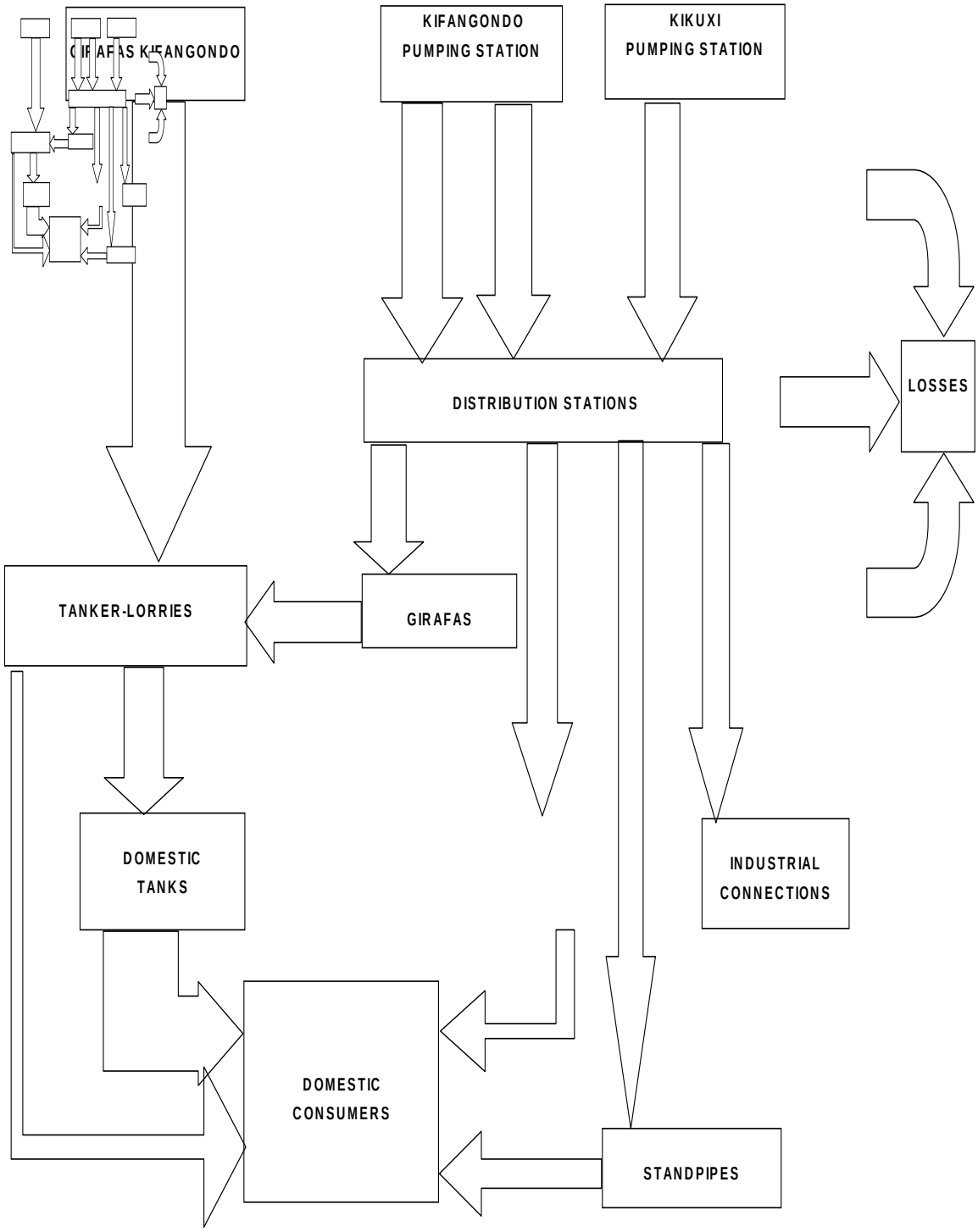
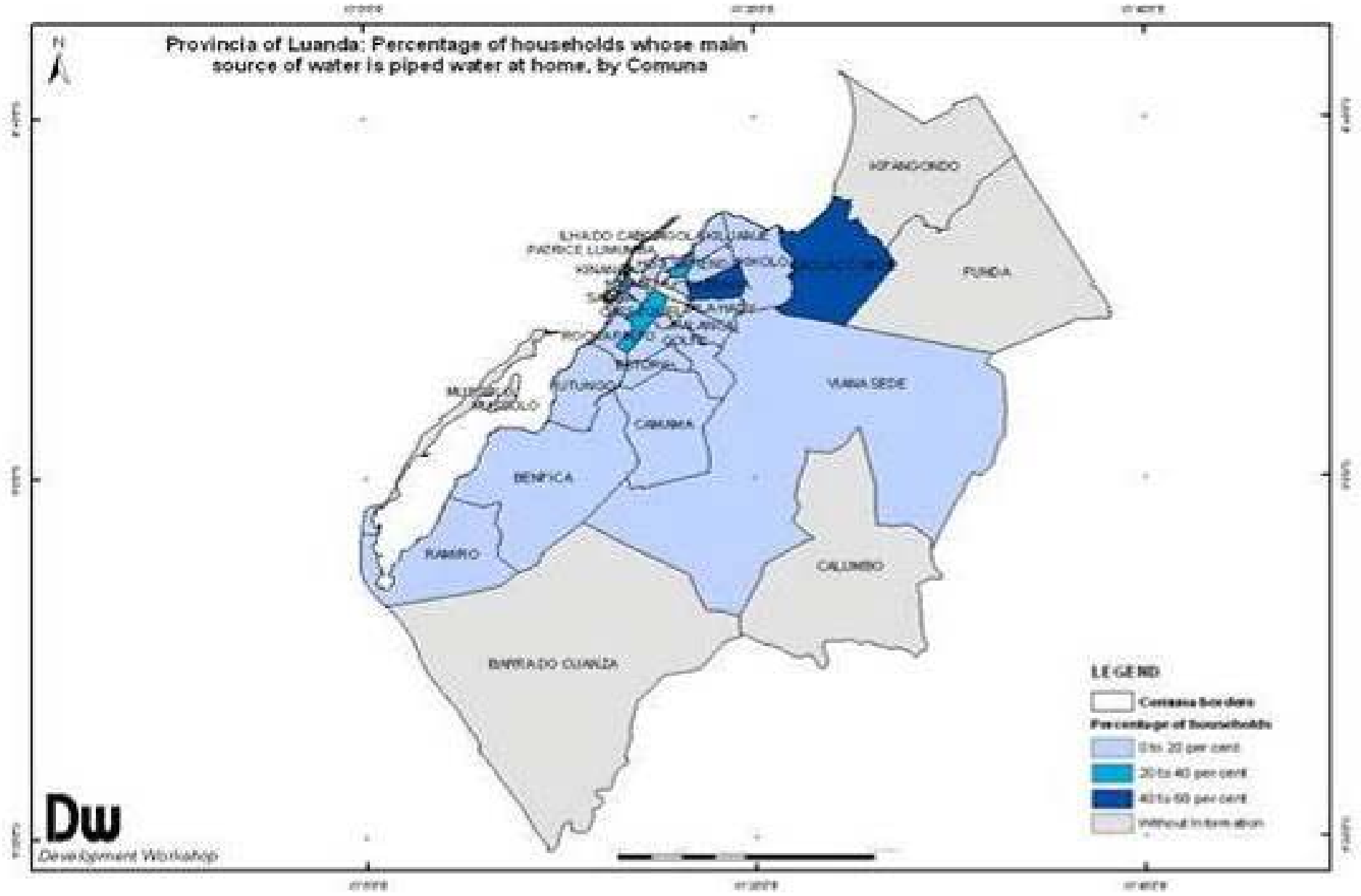
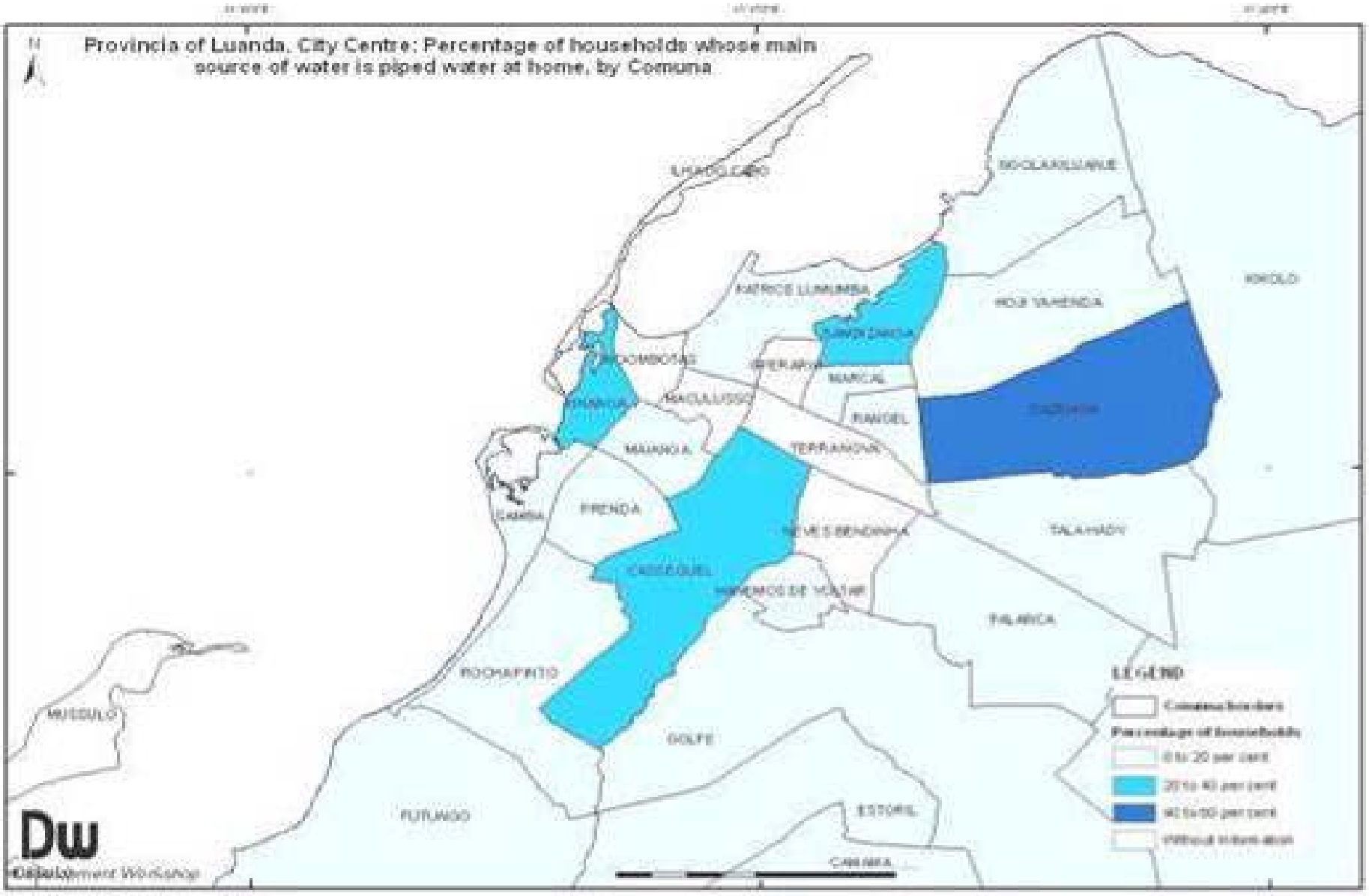


Diagram B How domestic consumers receive their water



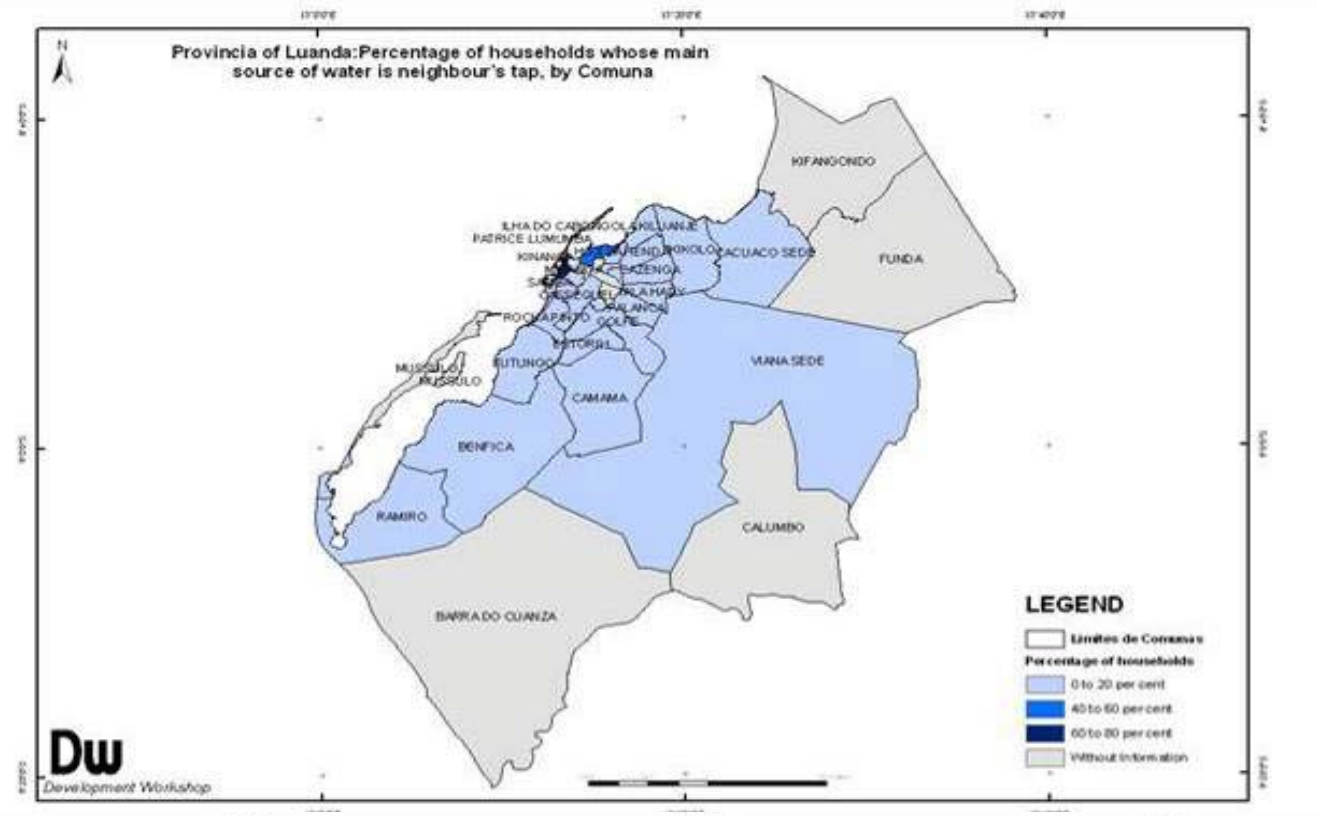

Condutas de Água que servem Luanda
N
Conduta 2
Conduta 1
OCEANO ATÂNTICO
CAZENGA
LEGENDA
Limite de Municipio

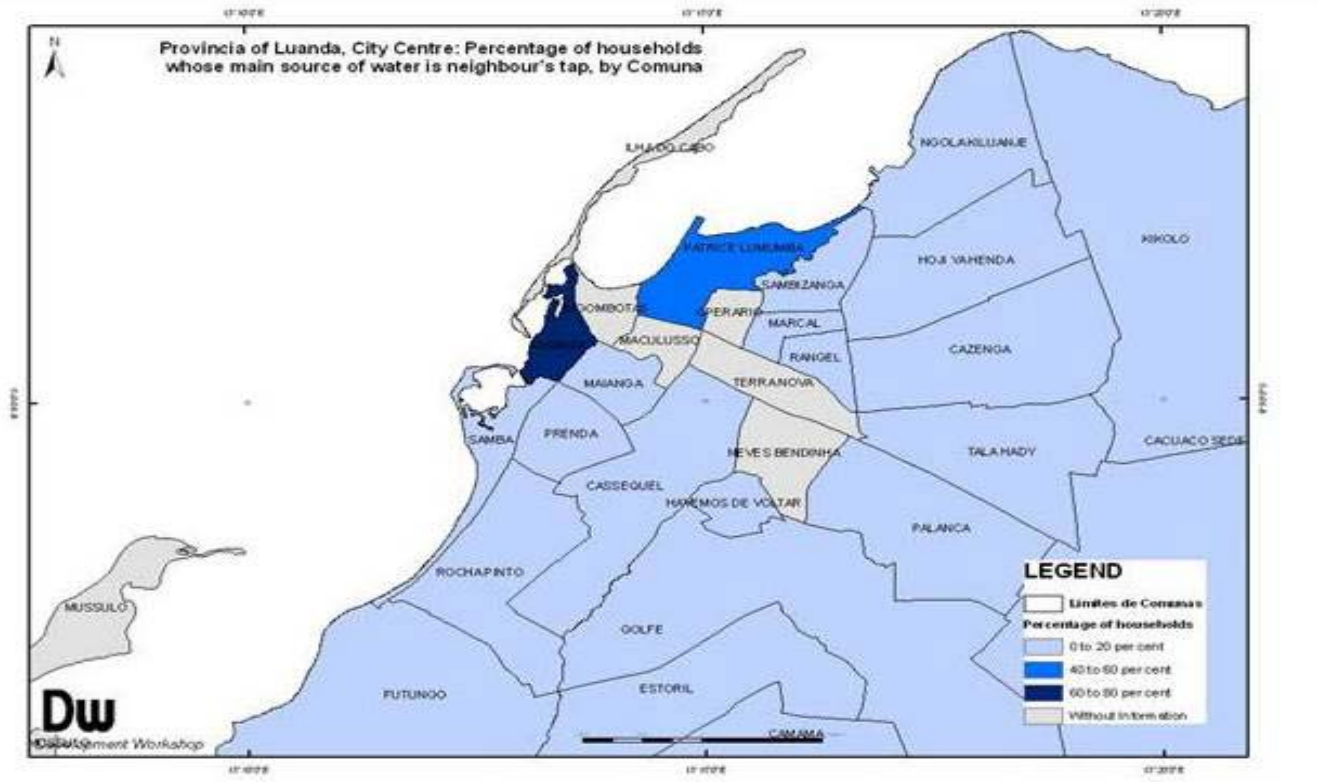

Provincia of Luanda: Percentage of households whose main source of water is piped water at home, by Comuna
N
KIFANGONDO
ILHA DO CABO
PRAIA DO BISPO
FUNDA
VIANA SEDE
CAMAMA
BENFICA
KILAMBA KIAXI
KAMIRO
CACUACO
BARRIO DO CUANZA
CALUMBO
LEGEND
Comuna boundaries
Percentage of households
0 to 20 per cent
20 to 40 per cent
40 to 60 per cent
Without information
Dw
Development Workshop


Provincia of Luanda. City Centre: Percentage of households whose main source of water is piped water at home, by Comuna
N
LUANDA CAIXA
BOAVISTA/LUANDE
KIKOLO
PATRICE LUMUMBA
ROQUE SANTEIRA
SAMBIZANGA
CAMBAMBOLO
MARCAL
KAKUALUSSO
RANGEL
MAIANGA
TERRANOVA
PRENDA
CAMAMA
NEVES BENDINHA
CAZENGUEL
TALATONA
HOMEMS DE NEGRO
PALANCA
ROCHA PINTO
MUSSULO
GOLFE
FUTUNGO
ESTORIL
CAMAMA
LEGEND
Comuna boundaries
Percentage of households
0 to 20 per cent
20 to 40 per cent
40 to 60 per cent
Without indicators
Dw
Development Workshop

4.3 Neighbour's taps

Although only 8% of households obtain water through their own domestic water supply, another 4% obtain water from somebody else's tap. This form of access to water is found only in areas close to the centre of the city that have piped water (the Comunas of Kinanga and Patrice Lumumba). There is less space to build a water tank, so water is distributed directly from a tap and not from a tank. The neighbour may not be an immediate neighbour, and in some cases households walk to another bairro to obtain water.





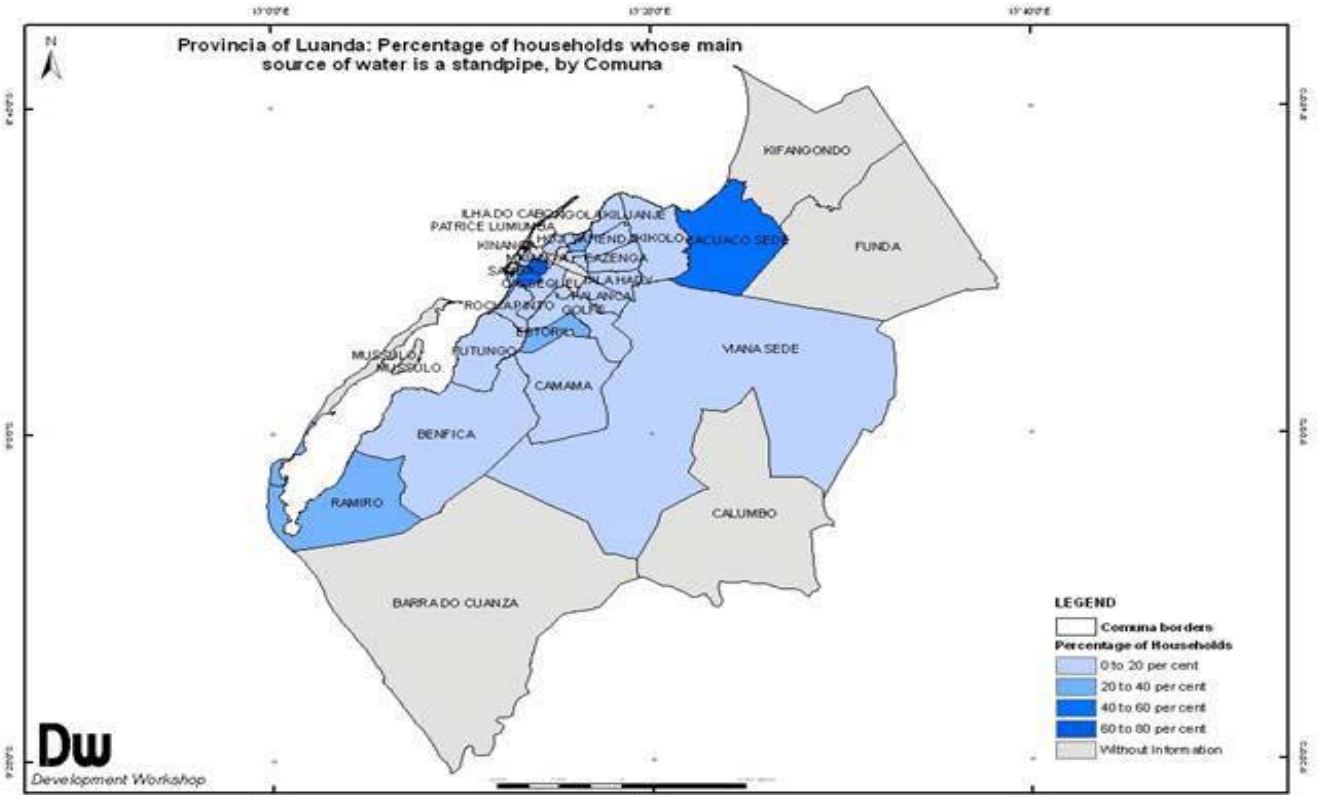
4.4 Standpipes

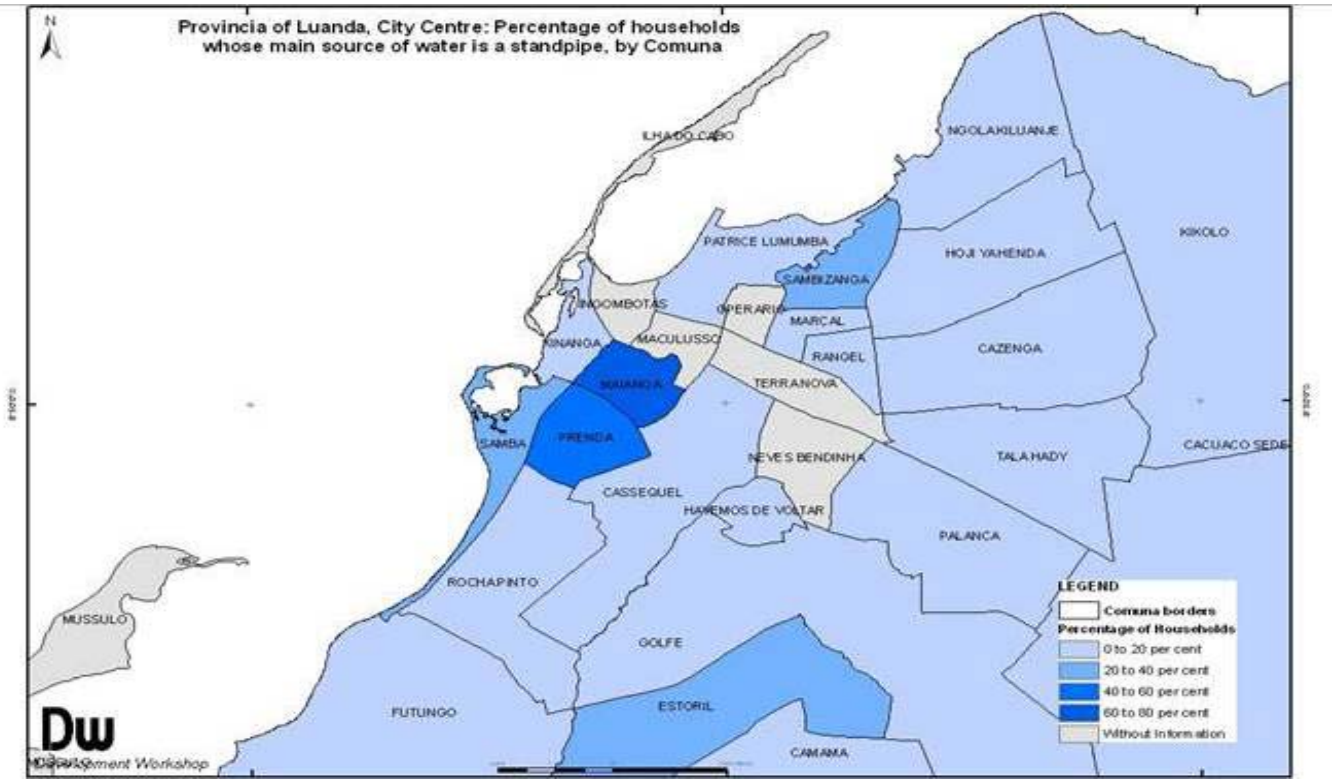
Standpipes are built within neighbourhoods that have an available connection to the water pipeline. These standpipes are constructed by EPAL or NGOs and usually serve about 1,000 people each.

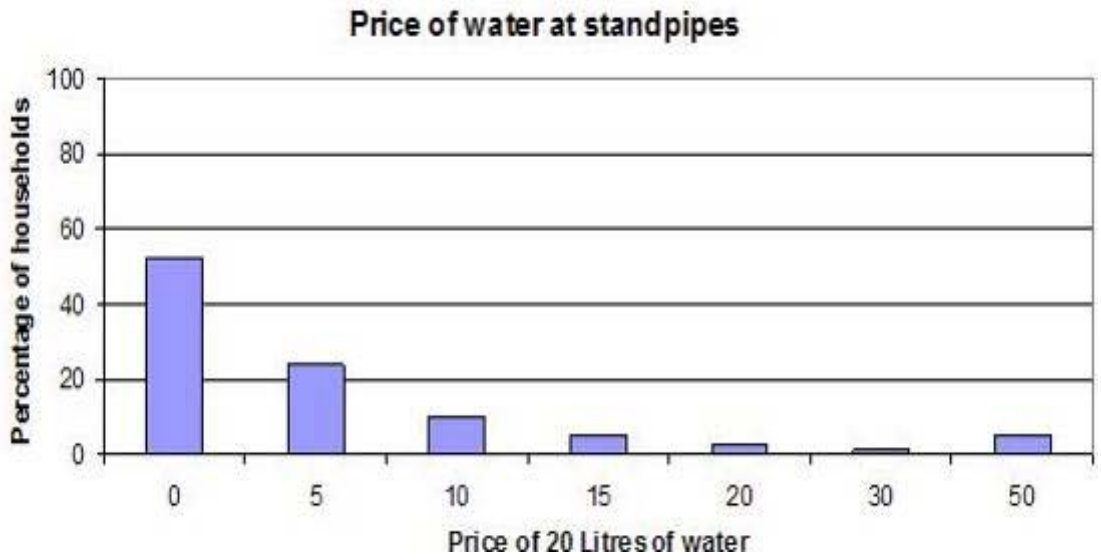
Access to water through standpipes tends to be in small pockets as standpipe projects usually cover only very limited geographical areas. In the bairro Maria Eugenia of the Comuna of Vila Estoril, all households reported that their main source of water was a standpipe while no households reported this source of water in other parts of the Comuna. In the bairro of Camuxiba in the Comuna of Samba, 85% of households reported that their main source of water was a standpipe while no households reported this source of water in other parts of the Comuna.

In the cases of standpipes built by NGOs, committees are elected by users to manage each standpipe, and community councils (ACAS) are created from these to manage the network of standpipes in the area. In the cases of standpipes owned by EPAL the monitors are either people paid by EPAL or by persons who have become managers by default.

Line of jerry-cans marking places in a queue for water


Provincia of Luanda: Percentage of households whose main source of water is a standpipe, by Comuna
KIFANGONDO
FUNDA
CACUACO SEDE
VIANA SEDE
CAMAMA
BENFICA
RAMIRO
CALUMBO
BARRA DO CUANZA
MUSSULO
FUTUNGO
ESTORIL
GOLFE
PALANCA
CASSEQUEL
TALA HADY
KIKOLO
CAZENGA
LEGEND
Comuna borders
Percentage of Households
0 to 20 per cent
20 to 40 per cent
40 to 60 per cent
60 to 80 per cent
Without Information
Dw
Development Workshop


Provincia of Luanda, City Centre: Percentage of households whose main source of water is a standpipe, by Comuna
ILHA DO CABO
NGOLA KILUANJE
PATRICE LUMUMBA
HOJI YA HENDA
KIKOLO
SAMBIZANGA
INGOMBOTAS
OPERARIA
MARCAL
KINANGA
MACULUSSO
RANGEL
CAZENGA
MAIANGA
TERRA NOVA
SAMBA
PRENDA
NEVES BENDINHA
TALA HADY
CACUACO SEDE
CASSEQUEL
HAVEMOS DE VOLTAR
PALANCA
ROCHA PINTO
MUSSULO
GOLFE
FUTUNGO
ESTORIL
CAMAMA
LEGEND
Comuna borders
Percentage of Households
0 to 20 per cent
20 to 40 per cent
40 to 60 per cent
60 to 80 per cent
Without Information
Dw
Development Workshop



The average price of water purchased from a standpipe is 0.32 Kwanzas per litre (6.45 Kwanzas for 20 Litres). The price of water at a standpipe varies between areas of the city, because standpipes are usually part of projects with their own objectives and rules. In Ngola Kiluanje the price of 20 litres of water at a standpipe is 5 Kwanzas, in Cacuaco it is 10 to 15 Kwanzas and in Viana Sede and Ramiro it is zero. About half of users of standpipes say that the price is zero and just over 20% say that the price is 5 Kwanzas for 20 litres. Others report higher prices.

Standpipes that are part of EPAL projects sometimes use a card that costs 50 Kwanzas and is valid to purchase 1000 litres of water. There are 50 squares on the card and one should be punched each time 20 litres of water are purchased. The aim is to make the purchase price of water at a standpipe very low. In practice the availability and use of these cards is irregular and in some cases they appear to have fallen into disuse as the system is too complicated. Monitors who have not been paid regularly charge 5 Kwanzas per 20 litres in exchange for organizing and securing the area.

NGO projects generally charge 5 Kwanzas or 10 Kwanzas for 20 litres, usually after consultation with users over what would be a fair price and what will cover the costs of a monitor, repairs, maintenance and payment to EPAL for the water. Non-governmental organizations thus play a role in providing low -income communities in Luanda with water, mainly in the local level of organisation, which is a key part of the process of providing water through standpipes.

Councils have been formed to represent the interests of communities about water (though some also take on other areas of interest). These are known as ACAS (Associações dos Comités da Água) or ODAS .

5 The informal water supply system of Luanda

5.1 Overview: Services provided in the chain

The informal peri-urban water market in Luanda probably turns over more than 250 Million US Dollars per year. It provides almost 20 litres or water per person per day to almost 4 million people at a price of about 0.01 US Dollars per litre.

The services that are provided in the supply-chain include:-

- Pumping (removing water from the river)
- Transport and distribution (by tanker-lorries, *roboteiros* and street-vendors)
- Treatment
- Storage (In tanks)

The water for the informal water supply system comes from *girafas* (supply points where tanker-lorries fill up), on the River Bengo at Kifangondo, from other *girafas* that supply water from the EPAL distribution system, from illegal connections to the pipeline and from the re-sale of water by households with domestic connections. Water from Kifangondo *girafas* is untreated, while in theory water from all other sources should have passed through a treatment plant. Originally EPAL had planned to put the *girafas* in sites around the city where underground pipelines could not be built (as was recommended in DW's study of 1995), but in practice they were constructed on the sites where EPAL treatment centres were already located at some distance from places with poor access to piped water.

Private water tanks obtain water from tanker-lorries or from piped water supply and usually sell to neighbouring households. The formal and the informal water sectors thus are related to each other. There are also people who sell water in the street in small bottles or plastic bags, and *roboteiros* who carry water in jerry cans (on their heads or on wheelbarrows) from tanks or taps to the house.

The main actors in the informal water supply system are therefore:

- owners of the water pumps that supply the *girafas* at Kifangondo
- owners of tanker-lorries
- ANGOMENHA, an Association representing owners of pumps and tanker-lorries
- households which own water tanks to re-sell water
- *roboteiros*
- street vendors
- the DNA water treatment station which is supposed to add chlorine to tanker-lorries from Kifangondo.

5.2 Girafas and tanker-lorries

5.2.1 Girafas and their location

There are ten principal points where tanker-lorries fill up with water to supply water to Luanda. The location of these points is shown on the map on page 24. The principal filling point (measured both in terms of numbers of vehicles and quantity of water) is **Kifangondo**. This is located on the River Bengo near to the bridge carrying the main road north out of Luanda, and is about 20 kms north of the centre of the city. This is the only *girafa* where water is extracted directly from a river (the other *girafas* obtain water from EPAL's water system). There are 29 individual *girafas* at Kifangondo, each with a motor-pump to pump water from the river. The site where tanker-lorries stand has been substantially improved over the last 10 years by the ANGOMENHA and the Municipality of Cacuaco. There is a hard surface with little standing water. Access and turning around is easy. The disadvantage of Kifangondo is that it is distant from the city, and increasing traffic congestion increases the journey time of each trip. However the low waiting times and good conditions mean that some tanker-lorries are attracted to Kifangondo rather than to some of the other *girafas* closer to the city.

Tanker-lorries filling-up from the River Bengo at the *girafas* at Kifongondo

The other *girafas* supply water from the EPAL system to water tanker-lorries. The *girafas* at **Viana Vila, Viana Capalanca** and **Maianga** only supply very small amounts of water. Observations showed that on many days there were electricity cuts that stopped supply early in the day or prevented any supply at all. For this reason few tanker-lorries use these supply points and they are mainly older and smaller lorries that cannot make the journey to more distant *girafas*: the owners fear that the lorries will break down or that the Police will object to the state of the lorries. The conditions at these points are good: access is reasonable, there is little water on the ground and the surface has not been broken up, but this is because these points have not been used much. The tanker-lorries tend to arrive very early in the morning because there

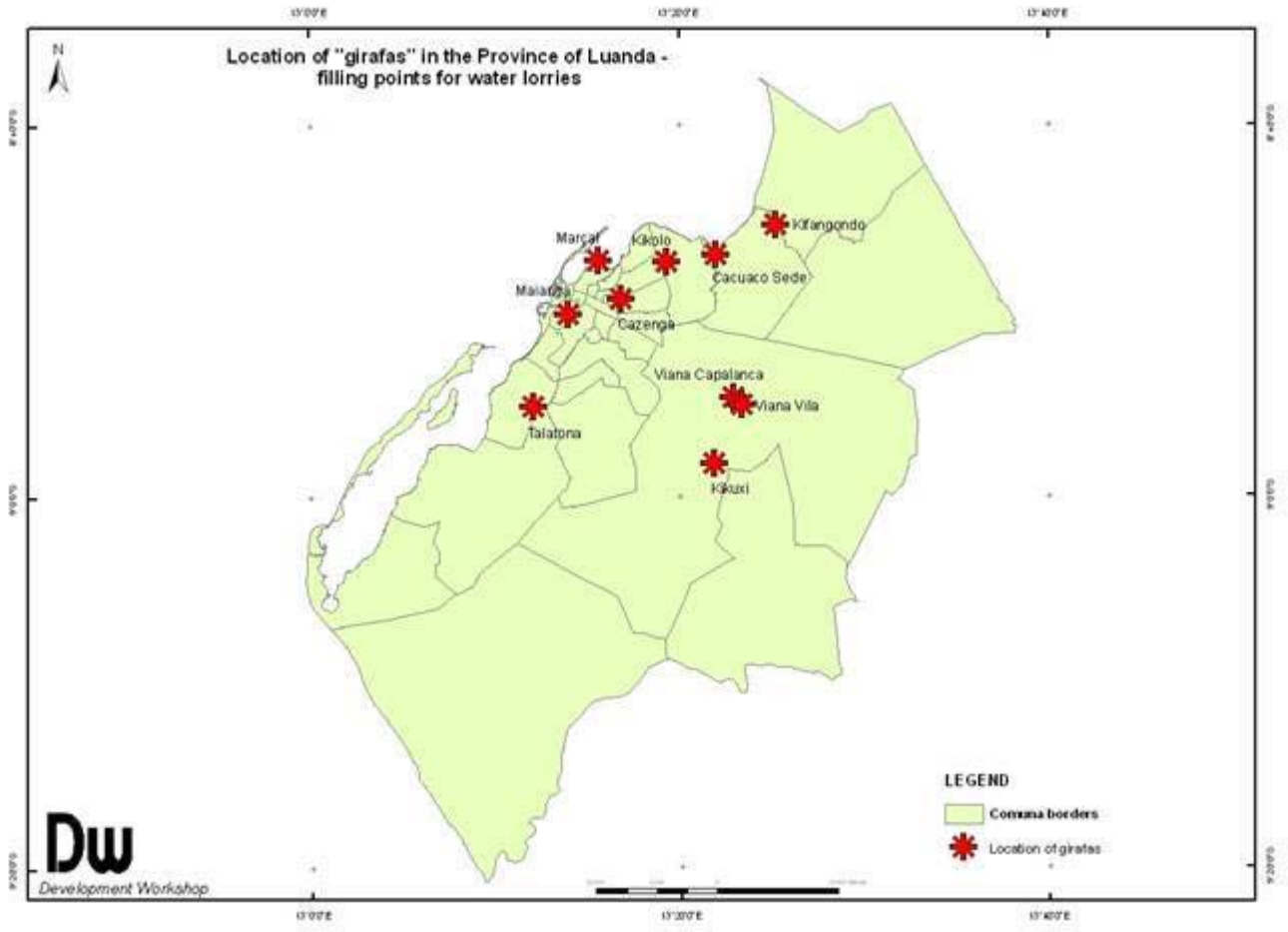
are better chances of there being water and electricity, and some wait all night to be first in the queue. Demand for water in the areas served by these *girafas* (and particularly Viana) is high because people are moving in to the area and there is a lot of construction work.

At the *girafa* at **Cacuaco Sede**, the rate of delivery of water is higher than at Viana or Maianga, but it is erratic. This supply point attracts more tanker-lorries, because the supply is reasonable, but there is usually a long line of vehicles waiting to be served and the queue causes delays to traffic along the main road. It was observed that on some days it closed in the evening when it got dark even though there was still a long line waiting to be supplied, and lorries arrive very early in the morning to be at the head of the queue. There is a lot of stagnant water on the ground that has been spilled or comes from leaking tanks and it is difficult for lorries to manoeuvre in the space available after they have filled up. A small market has grown up with stalls selling cooked food to the waiting drivers and assistants.

Access is difficult to the *girafa* at **Marçal,** which is part of an EPAL distribution centre. The road surface has been damaged by the constant passing of lorries and the leaking of water from lorries and the *girafa* and there is always a large pool of water on the ground. The small lorries have difficulty in maintaining traction while the large lorries have difficulty in turning around. The *girafa* in practice opens at about 04H30 while the official time is about 07H00. There is a tendency for small lorries belonging to individuals to be there earlier in the morning while later there are more larger lorries and those belonging to large companies. There would appear to be few difficulties of supply at this point and it could probably supply more water if access were easier.

At **Kikolo** there are a number of informal supply points for tanker-lorries which provide water to older, smaller lorries and also some tractors with trailer tanks. The supply points are in fact private tanks that are supplied by holes in the EPAL pipeline. The tanks are inside enclosed spaces surrounded by walls and there are flexible pipes that are passed over the walls to supply water to the tanker-lorries and trailers, using motor pumps to pump the water. Some of the points are difficult to access and there is some excess water on the roads because most of the vehicles leak. These informal supply points are said to be illegal. It was observed that staff of EPAL and the police visited the site and tried to stop the activity, but it resumed later. The residents of the area are very much in favour of the activity continuing.

Kikuxi is a relatively new official supply point on a new EPAL pipeline. The rate of supply is good though there is some difficulty in access to this point because the road is sandy. The turnover of tanker-lorries is rapid though there is still usually a queue, because lorries are attracted to this point by the good supply and because this it is the best supply point for the rapidly growing Viana area. A small market has developed for drivers waiting here, with numerous stalls selling cooked food.



Talatona is another relatively new official supply point on a new EPAL pipeline serving the rapidly growing southern part of the city where there is little piped water. Access is reasonable and the point attracts larger lorries.

Cazenga is a well-established *girafa* at the EPAL distribution centre of Cazenga, though the amount of water supplied at this point would appear to have increased since the mid-1990s. Access and conditions are reasonable and it attracts a large number of lorries each day.

Each supply point has its own opening hours. At many points there is a tendency for the operators to arrive earlier than the established timetable and it appears that drivers pay the operators at the *girafas* extra for opening early. Drivers prefer to work earlier in the day when there is less traffic and when they hope that there is a shorter queue to fill-up. It also provides the opportunity to do more journeys if there is a need.

5.2.2 Amount of water supplied by girafas

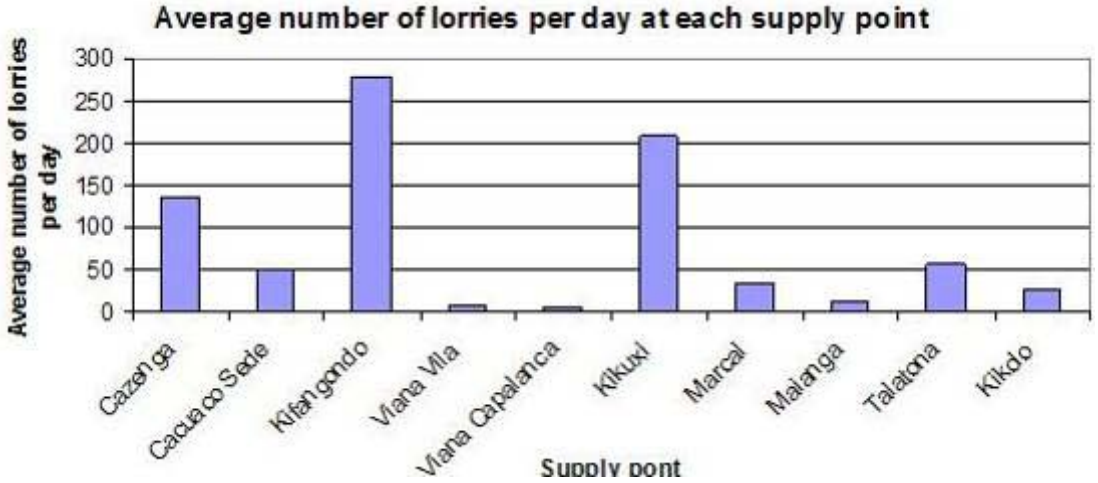
On an average day about 278 lorries fill up with water at Kifangondo, 209 at Kikuxi and 135 at Cazenga. The daily average at the least frequented *girafas* is 7, 9 and 13 (Viana Capalanca, Viana Vila and Maianga) In total on an average day 822 lorries fill up with water at one of the *girafas* serving Luanda[6]. There are however differences in the average size of lorry filling up at each *girafa*: at Kikolo the average size of lorry is just over 4 cubic metres and at Viana Capalanca, Viana Vila it is between 8 and 9 cubic metres, while at Talatona it is over 16 cubic metres and at Kikuxi it is over 14 cubic metres. There are therefore substantial differences in the amount of water transported each day at each *girafa.* A total of over 11,000 cubic metres is transported each day from the 10 *girafas* but 34% of this comes (3819 cubic metres) from Kifangondo and 27% (3141 cubic metres) comes from Kikuxi. Cazenga contributes 16% (1810 cubic metres) and Talatona contributes 9% (974 cubic metres). At the other end of the scale, Viana Capalanca, Viana Vila, Kikolo and Maianga contribute about 1% each.

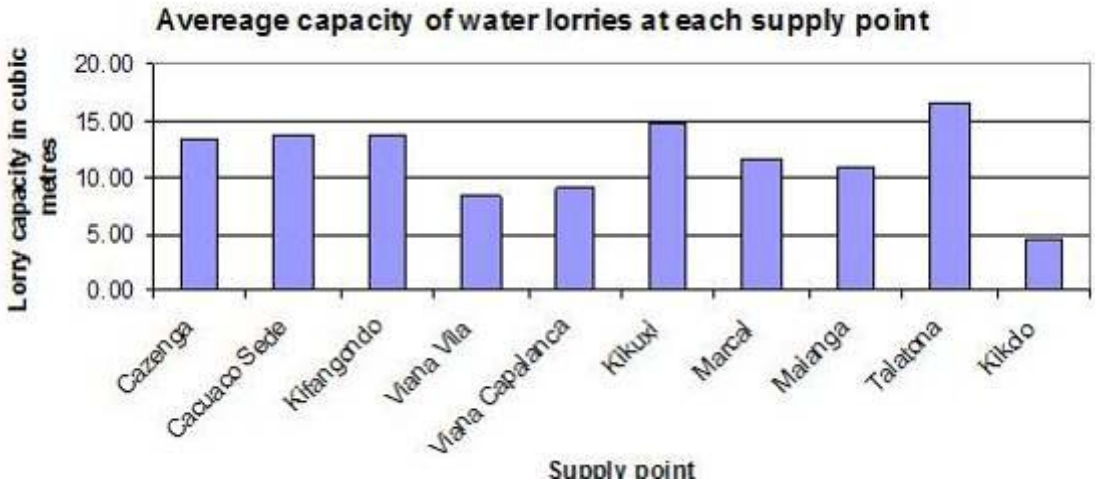
The total amount of water being supplied to tanker-lorries (11,262 cubic metres on average per day) is greater than the amount estimated in 1995 (9,000 cubic metres per day). In 1995 however most of this was believed to be supplied from Kifangondo with small amounts from Cazenga and Marçal. In 2006 less is being supplied from Kifangondo but significant amounts of water are being supplied to tanker-lorries at Kikuxi and more is being supplied at Cazenga. This reflects the improvements made to the piped water system and means that there is a source of water for tanker-lorries supplying the fast-growing southern area of the city of Luanda. Talatona also supplies this area. The distance to Kifangondo and increasing traffic congestion have probably also led to a decrease in the number of lorries filling-up at Kifangondo. This in turn means that the distance from Kifangondo has less impact on the price of water and the ease of supply of water.

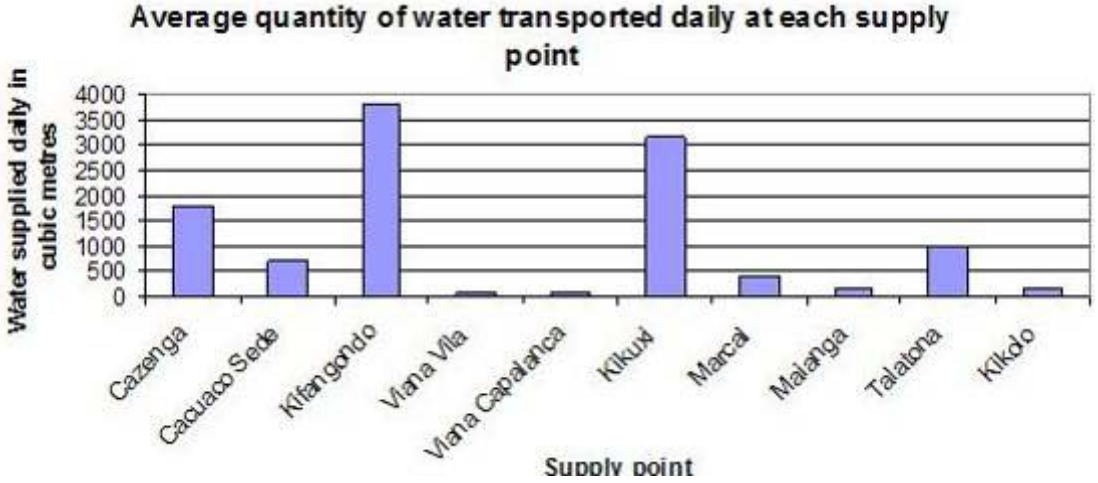
Tanker-lorries deliver water to households that have built water tanks. Sometimes this is for the consumption of the household itself and sometimes for re-sale. The main areas where households supply themselves with water directly from tanker-lorries are south of the city centre. As the map shows there are some areas (Comunas of Samna and Futungo) where between 40 and 60% of households supply themselves with water this way. These are areas that are distant from piped supplies but where there are households with sufficient resources to have their own water tanks.

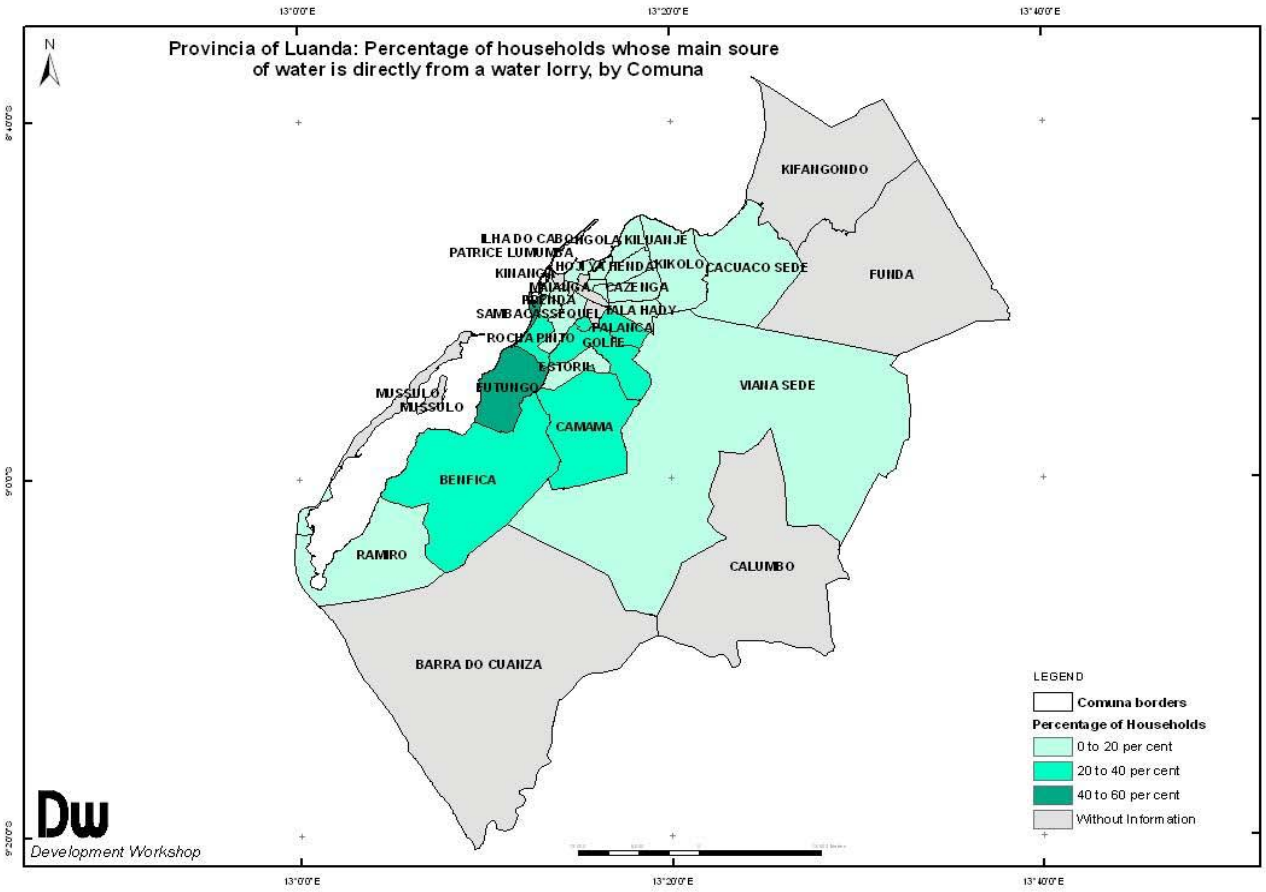
When they have filled up with water, tanker-lorries wait at various well-known points where they can be contacted by customers. In the past, customers would go to these points to ask for a delivery or wait by the road to hail a tanker-lorry. It is now more common for customers to order a delivery by mobile telephone.

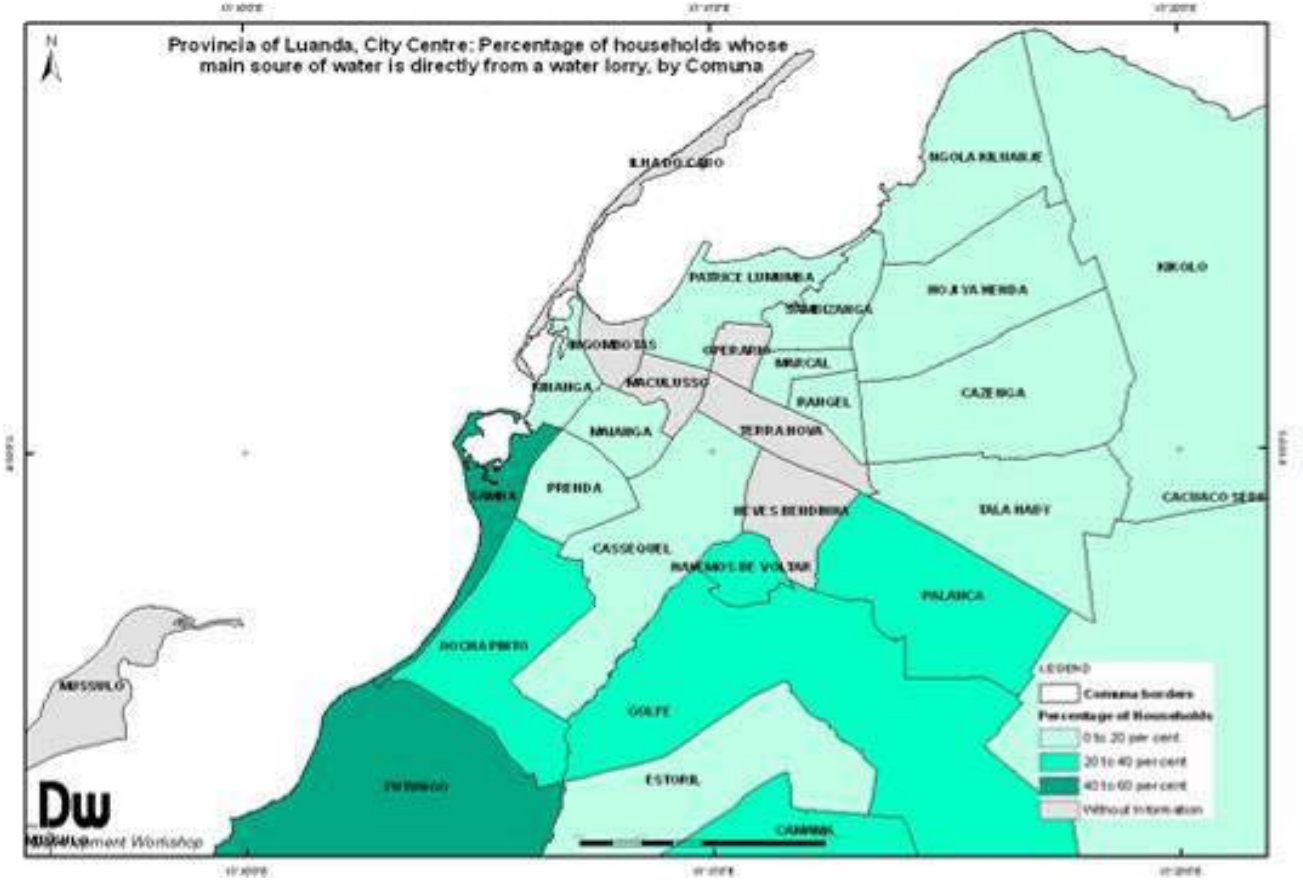
[6] There are fewer tanker-lorries filling up with water on a Saturday and even fewer on a Sunday. The figures given here have been calculated by dividing the weekly total of lorries from the observations made at each site by seven. The number of tanker-lorries on Mondays to Fridays is usually higher than this daily average.


Average number of lorries per day at each supply point
Average number of lorries per day
300
250
200
150
100
50
0
Cazenga
Cacuaco Sede
Kifangondo
Viana Vila
Viana Capalanca
Kikuxi
Marcal
Maianga
Talatona
Kikdo
Supply point


Avereage capacity of water lorries at each supply point
Lorry capacity in cubic metres
20.00
15.00
10.00
5.00
0.00
Cazenga
Cacuaco Sede
Kifangondo
Viana Vila
Viana Capalanca
Kikuxi
Marcal
Maianga
Talatona
Kikdo
Supply point


Average quantity of water transported daily at each supply point
Water supplied daily in cubic metres
4000
3500
3000
2500
2000
1500
1000
500
0
Cazenga
Cacuaco Sede
Kifangondo
Viana Vila
Viana Capalanca
Kikuxi
Marcal
Maianga
Talatona
Kikdo
Supply point


Provincia of Luanda: Percentage of households whose main soure of water is directly from a water lorry, by Comuna
13°0'0"E
13°20'0"E
13°40'0"E
8°40'0"S
8°60'0"S
8°20'0"S
N
KIFANGONDO
FUNDA
ILHA DO CABO
NGOLA KILUANJE
PATRICE LUMUMBA
KIKOLO
CACUACO SEDE
KIANGA
CAZENGA
SAMBA CAJU
TALA HADY
PALANCA
ROCHA PINTO
GOLFE
ESTORIL
VIANA SEDE
MUSSULO
BUTUNGO
CAMAMA
BENFICA
RAMIRO
CALUMBO
BARRA DO CUANZA
LEGEND
Comuna borders
Percentage of Households
0 to 20 per cent
20 to 40 per cent
40 to 60 per cent
Without Information
Dw
Development Workshop


Provincia of Luanda, City Centre: Percentage of households whose main soure of water is directly from a water lorry, by Comuna
N
ILHA DO CABO
NGOLA KILUANJE
PATRICE LUMUMBA
KIKOLO
CAZENGA
KIANGA
MAZIUSSO
MUTAMBA
PRENDA
CASSEQUEL
PALANCA
ROCHA PINTO
MUSSULO
GOLFE
ESTORIL
CAMAMA
LEGEND
Comuna borders
Percentage of Households
0 to 20 per cent
20 to 40 per cent
40 to 60 per cent
Without Information
Dw
Development Workshop

5.2.3 Characteristics of tanker-lorries, drivers and owners

Seventeen per cent of drivers of tanker-lorries are owners of their vehicles. Another 60% of tanker-lorries belong to private owners and 13% belong to companies. The average company owns 10 vehicles. The average number of vehicles owned by drivers or private owners is 1.8. More than half of small-scale operators have one vehicle and another quarter have two vehicles. Thus, there does not seem to be much concentration of ownership in the tanker-lorry business, apart from the 13% of vehicles belonging to companies.

Of the drivers who were interviewed, 55% say that they started in this occupation in the previous 5 years and 82% that they started in this occupation on the last 10 years. The average time that drivers have been in the business is 5.3 years. There appears to have been an influx of drivers into the business in 2002 at the time of demobilisation. Owner-drivers have been in the business an average of 6.6 years, those working for a private operator for 3.9 years and those working for a company 8 years. All drivers claim to have a professional or goods vehicle driving licence.

Drivers normally have a young man as an assistant who is paid between 4000 and 6000 Kwanzas per week. The average is 5,600 Kwanzas per week.

On average each tanker-lorry makes three journeys per day, according to the information of the drivers, with little variation between tanker-lorries that fill at the different *girafas* or between the types of operator. The average capacity of tanker-lorry observed in bairros delivering water is 11,100 litres, which is close to that observed at the *girafas*. The most common size of tanker-lorry is 10,000 litres, followed by 15,000 litres and then 5,000 litres. Those owned by companies are most likely to be 10,000 litres capacity or 15,000 litres capacity, and are rarely 5,000 litres. The average size of a lorry owned by a company is 12,000 litres, one owned by the driver 9,400 litres and one owned by a private operator is 10,900 litres.

Drivers state that they choose where to sell water, and the main factors are the speed at which it can be sold, followed by the proximity to the *girafa*. The price is determined by the driver. Drivers do not always sell in the same bairro. Half of them always use the same *girafa* while the other half uses different *girafa*s depending on where water is available and queues are shortest.

Drivers say that they are stopped on average 2.7 times per day by the Police and pay the Police an average of 750 Kwanzas each time that they are stopped. This adds 2040 Kwanzas to the daily costs. Ten per cent say that their vehicle is off the road on average one day per week due to lack of documents.

Tanker-lorries belonging to companies are least likely to be off the road due to mechanical problems, followed by those belonging to a private owner. On average 63% of tanker-lorries are off the road 1 day per week due to mechanical problems and 26% are off the road 2 days per week.

About 35% of drivers would become taxi-drivers if the water business declined, while another 35% would become long-distance lorry drivers and 23% would return to another profession.

Only 8% of drivers of tanker-lorries think that there is nothing that can be done to improve conditions in the informal water sector. The ways in which they think that conditions can be improved are:-

Construct more *girafas*	67%
Improve the state of roads	62%
Improve access at the *girafas*	50%

Fix purchase price at *girafas*	21%
Fix the sale price of water	12%

Fixing the prices of water is a strategy that is favoured by relatively small number of drivers. More useful, in the opinion of drivers, are strategies that increase the amount of water available, improve access to *girafas* and reduce the wear-and-tear on vehicles. Considerable time is spent in queuing for *girafas* and in maneuvering into position (except at Kifangondo, though there is a time penalty there in driving in and out of the city). Delivering water inside bairros means using very bad roads, especially rain. It is in the areas where roads are poorest that demand for water is highest.

5.2.4 Economics of tanker-lorry operation

The price of water increases significantly in the part of the supply chain between the *girafa* and the household or water tank. The following calculations have been carried out in order to assess whether this increase in the price of the product can be justified. The calculation is very approximate, as drivers of tanker-lorries (from whom the information was gathered) may not have access to all the information and there are probably significant variations in the costs between different operators.

Lorry owners state that the average price of water at the *girafas* is 130 Kwanzas per cubic metre (1.733 US Dollars per cubic metre) with little differences between areas of the city or between supply points. The official price charged by EPAL at the *girafas* is 95 Kwanzas per cubic metre, (EPAL's commercial and industrial tariff). The average sale price of water declared by owners of tanker-lorries is 770 Kwanzas per cubic metre (or 10.26 US Dollars per cubic metre). Owners of water tanks who purchase water from tanker-lorries say that on average they pay 640 Kwanzas per cubic metre. There is an increase by about a factor of five in the price of water through this stage of the supply chain.

Drivers were asked to calculate weekly costs for a number of different types of expenditure. This comes to 45,783 Kwanzas per week. According to the information provided by drivers, the average number of journeys made per day is 2.7 so, if we assume that drivers work between 5 and 6 days per week, the average number of journeys per week is about 16[7]. On average a tanker-lorry delivers 11.1 cubic metres of water on each journey, so it can be assumed that each tanker-lorry sells on average 180 cubic metres of water per week.

Weekly costs	Kwanzas
Mechanical repairs	12,600
Oil	5,376
Tyres	2,848
Filters	2,194
Fuel	6,665
Police	10,000
Assistant	5,600
Tax	500
TOTAL	45,783

The average purchase price of water at a *girafa* is 130 Kwanzas per cubic metre and the average sale price of water to a household with a tank is 770 Kwanzas per litre. Each cubic metre has a margin of 640 Kwanzas. An average income per week is thus 115,000 Kwanzas.

[7] In 1995 it was found that the average number of trips per day was 1.7. The opening of new *girafas* close to where people live would appear to have meant that each lorry can now serve more people. The low number of journeys per day in 1995 was also probably due to the fact that the only *girafas* functioning well were at Kifangondo which is quite distant from the centre of population.

	Kwanzas	Equivalent in US Dollars
Income per week from sale of 180 cubic metres of water[8]	115000	1533
Running costs	45783	610
Difference	69217	923

The margin of income over expenditure is just over 900 US Dollars per week, though from this has to come the salary of the driver, the depreciation of the vehicle and the profit of the owner.

We have estimated the cost of a new tanker-lorry at 200,000 US Dollars and that the cost in spare parts over the life of the vehicle effectively doubles the price. We have assumed that the value of the vehicle should be written off over 12.5 years (as was done in the 1995 study). This implies that the depreciation of the vehicle comes to 600 US Dollars per week, which leaves available only 300 US Dollars for the driver and owner.

Since 1995, the average sale price of water has almost doubled (in US Dollar terms) and the number of journeys that a lorry achieves has increased from 1.7 per day to 2.7 per day). However the average size of tanker-lorries appears to have decreased, possibly due to the entry into the market of 5,000 and 10,000 litre capacity lorries since the end of the war. Other costs have increased, such as fuel (which had almost zero cost in 1995), insurance and repair costs. The most significant cost is the depreciation cost of the lorry, which in 1995 was estimated to be over half the costs of running a tanker-lorry. The use of tanker-lorries leads to a high price for water because of the cost of the vehicle rather than any unreasonable profits by owners.

5.3 Household water tanks

Water tanks are constructed by individual households as a way of assisting their neighbours and to help them to pay household expenses. Sixty-five per cent say that they sell water to help the neighbours, 57% say that it helps to pay household expenses and 35% say that it is because there is no water in the bairro. Only 14% of households see it as an income generating activity. Sixty per cent of tank owners say that they are filled only from tanker-lorries, and the rest are filled from a piped connection or from both sources. Households that fill their tank from tanker-lorries are more likely to say that they sell water because there is no water in the bairro, because they are in areas where there are no alternative sources of water. Owners of tanks report that they sell water to anyone who wants to buy.

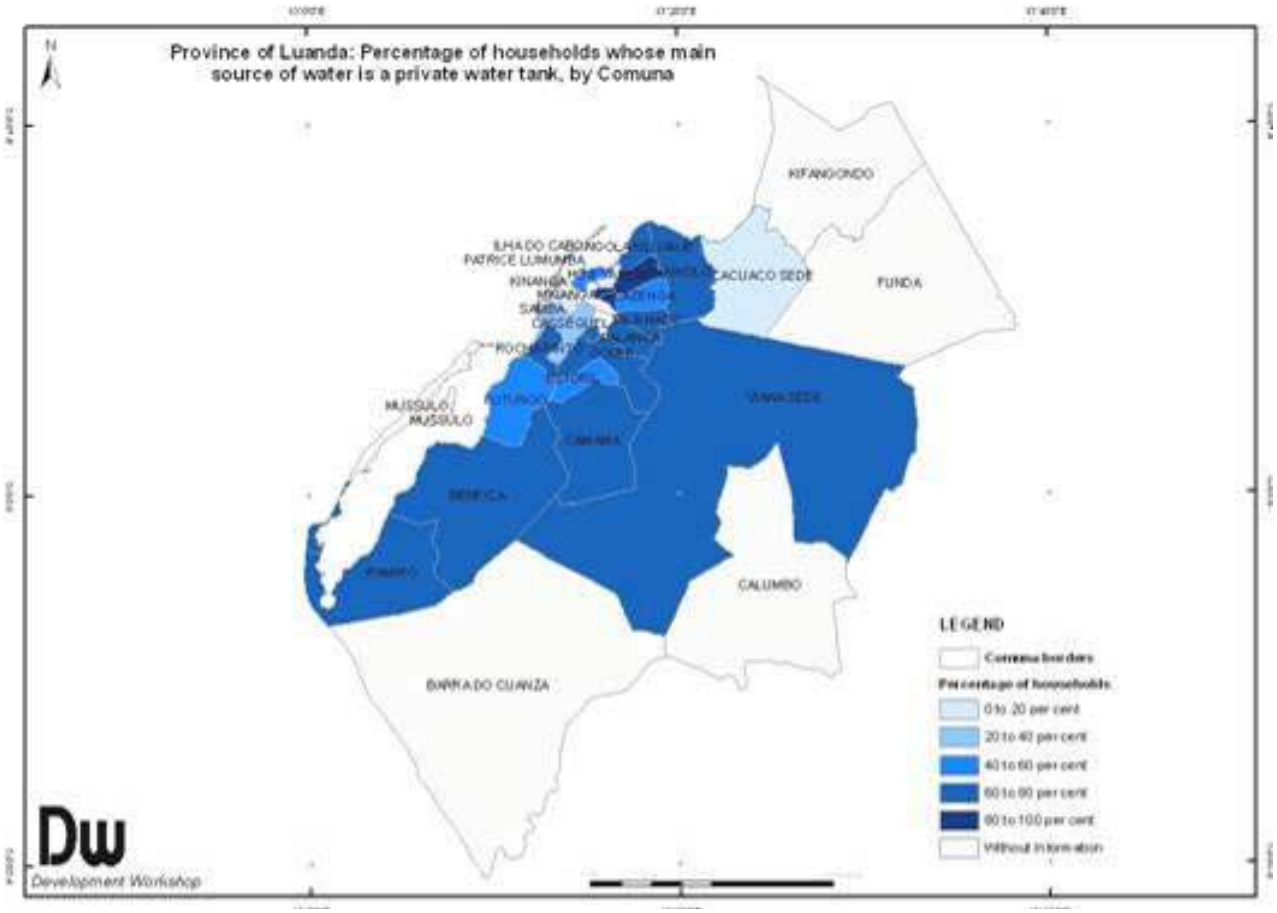
The income from sale of water appears to be used to reinforce household income to buy essentials.

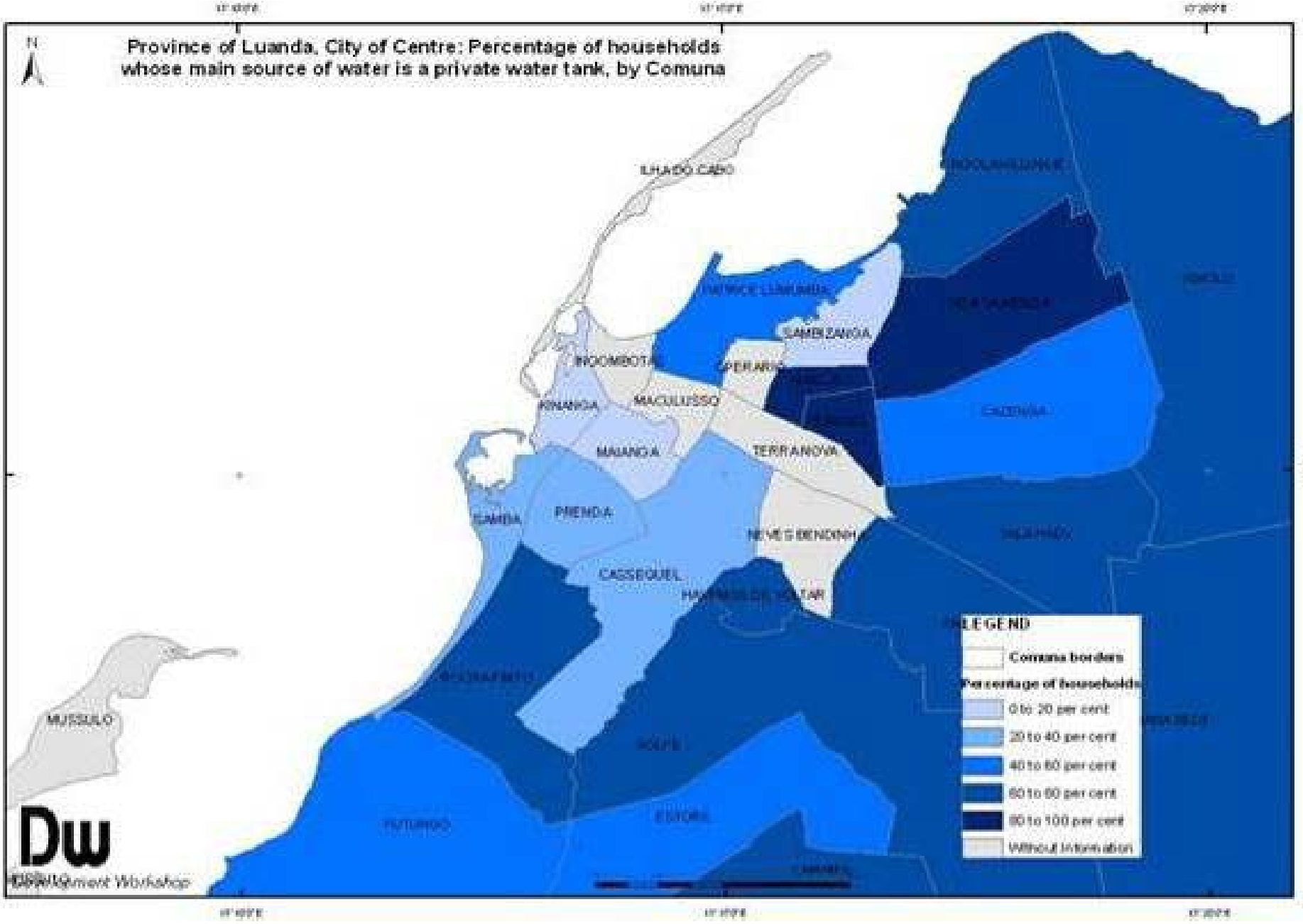
Use of income from sale of water	**Percentage of households selling water from tanks**
To buy food	91
To pay for transport	74
To buy more water	71
To pay school fees	53
To buy medicine	44

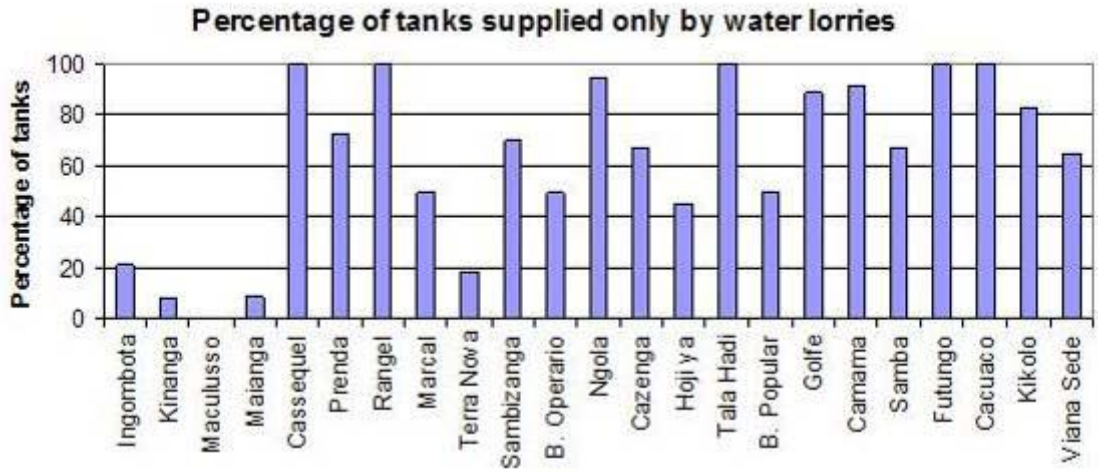
[8] Sale price less price at the girafa

The mean size of a peri-urban tank is 8.7 cubic metres. The most common size of tanks is 5.0 cubic metres and 10.0 cubic metres. Owners of tanker-lorries prefer to deliver to houses with tanks of 10.0 cubic metres, as this means that they can sell all of their water at one place and not have to seek another customer. However in many areas there is no space for larger tanks and households do not have the capital to build and fill a larger tank.

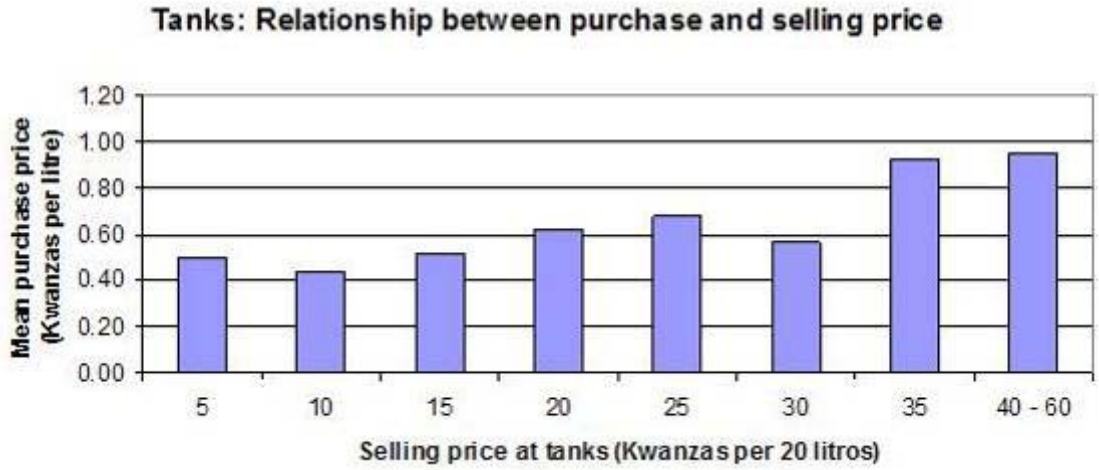
Tanks that are supplied by piped connection are more likely to be smaller ones (5 cubic metres) while those supplied by tanker-lorry are more likely to be 10 cubic metres or more. In areas where there is some supply of piped water, or piped water is nearby, the percentage of tanks supplied only by tanker-lorries is lowest.



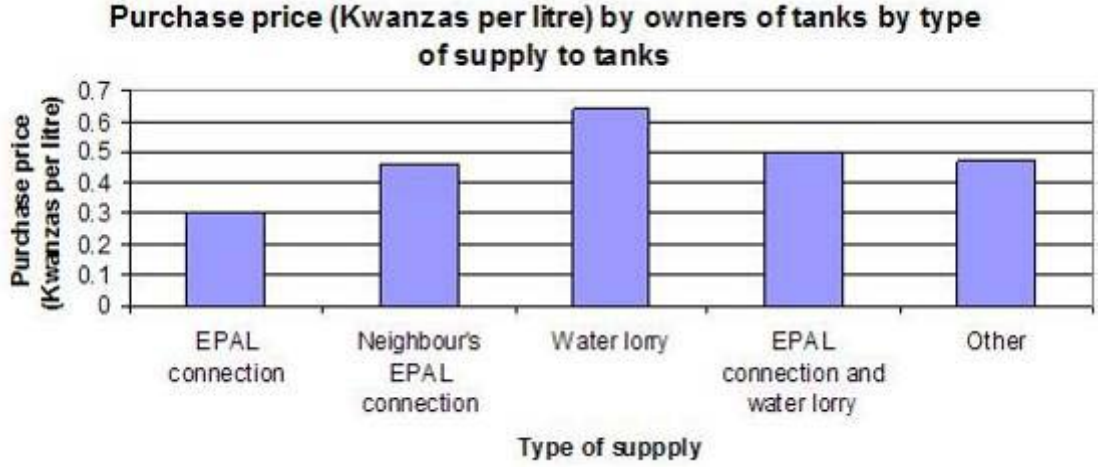

Province of Luanda, City of Centre: Percentage of households whose main source of water is a private water tank, by Comuna
N
LUANDA CABO
SAMBIZANGA
INGOMBOTA
KINANGA
MAIANGA
TERRANOVA
PRENDA
CAZENGUEL
MUSSULO
LEGEND
Comuna borders
Percentage of households
0 to 20 per cent
20 to 40 per cent
40 to 60 per cent
60 to 80 per cent
80 to 100 per cent
Without information
Dw



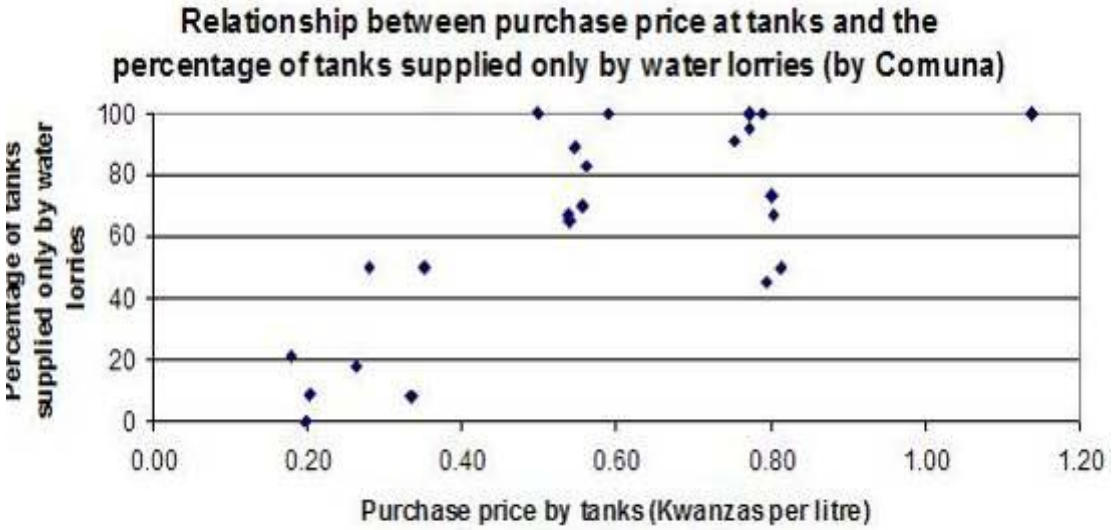
The majority of tank owners who obtain water from their own EPAL connection say that they pay nothing for their water, and another 20% say that the price is between zero to 0.45 Kwanzas per litre. The price paid for filling water from tanker-lorries is lower in the Comunas where there is also a piped water connection, and highest in Comunas that are most distant from the piped water system and from *girafas*. The mean sale price of water at water tanks is 0.86 Kwanzas per litre (17.27 Kwanzas for a 20 Litre container), which is 6.6 times the price of water at a *girafa*. The price at which water is sold to households at water tanks increases in line with the purchase price for the tank owner, but the profit margin is greater when the purchase price is higher.

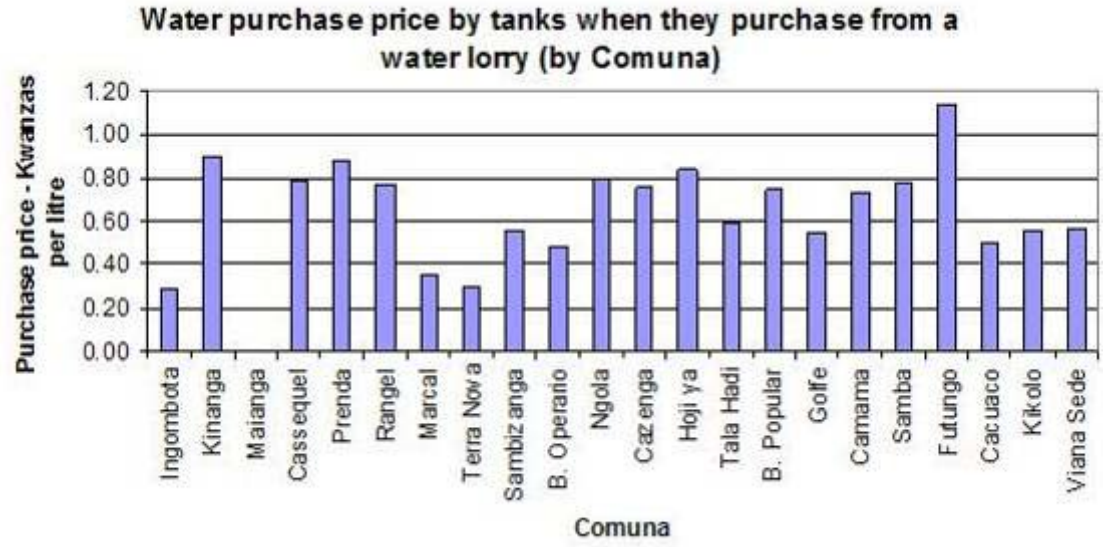


.

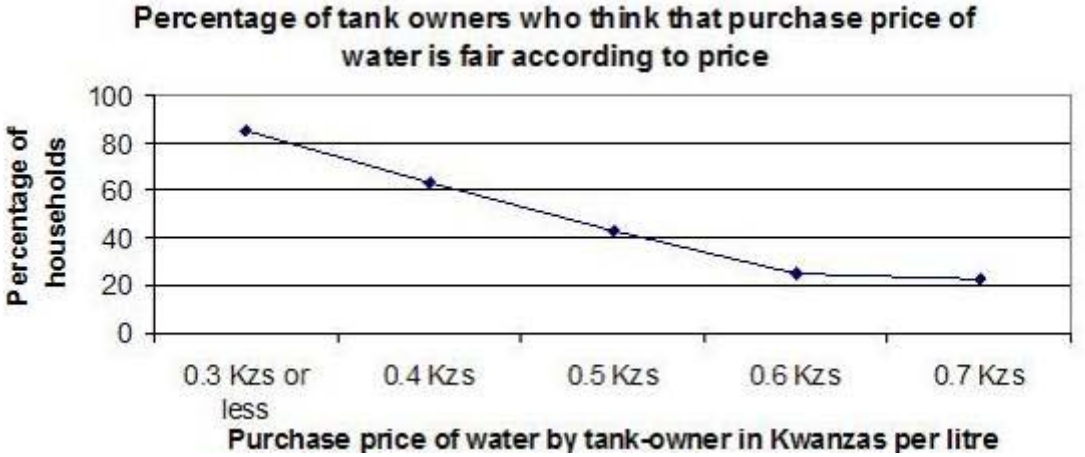


The price paid by owners of tanks is lower in the Comunas where there is also a piped water connection and higher in the Comunas where there is no EPAL connection. But this is not the only factor that determines the price paid for water by owners of tanks. Looking at only the price paid for water by owners of tanks who purchase from tanker lorries there are notable differences between Comunas. The price is lowest (less than 0.60 Kwanzas per litre) in Cacuaco, Kikolo, Viana Sede, Golfe, Bairro Operário, Ingombotas, Sambizamga, Marçal and Terra Nova. The price is highest in Futungo, which is the Comuna furthest from any *girafa*.





Only a third of tank owners think that the price that they pay for water is fair. The percentage who think that the price is fair decreases with price, as is shown in the following graph.



Of those who buy their water from tanker-lorries, a half always buy from the same one. However, this rarely means that they consider that they have a relationship with the driver: occasionally they may be a relative or friend but almost always it is considered as a business relationship. The average price paid for water is slightly higher when the tank-owner always buys from the same lorry. This implies that there is no discount for being a regular customer and that there might be a slight price advantage in seeking out other suppliers. Two-thirds of tank-owners say that they have a relationship of trust with the driver of the tanker-lorry, and the main reason for this is that the driver is always available when water is needed. Price is not a stated reason for a relationship of trust, and again the price is slightly higher when the lorry driver is trusted.

How often do you fill the tank? (tanks filled from tanker lorries)	Percentage
Weekly	28
Fortnightly	21
Monthly	28
Bimonthly	5
Other	18

The frequency of filling the tank varies between weekly, fortnightly or monthly. Those with tanks of 5,000 litres fill them more often than those with tanks of 10,000 or 12,000 litres. Thirty-five per cent of those with tanks of 5,000 litres fill them once a week but only 21% of those with larger tanks fill this frequently. Almost none of the tanks that have a piped water connection are

without water for more than 2 days per month. However for tanks which are supplied by tanker-lorry, a half are without water for more than 2 days per month and a quarter are without water for more than 5 days per month. The areas where tanks remain unfilled longest are those that are furthest from the supply points of water, such as the Comunas of Samba and Ramiro and the more distant bairros of Viana Sede. This corresponds with the observation that drivers of tanker-lorries prefer to supply areas that are closest to the *girafas* so that they can maximise the number of journeys that they make.

On average households selling water from tanks have been doing so for just over 4 years. Twenty per cent have been selling for one year or less, 38% for 2 years, 13% for 3 years, 6% for 4 years and 21% for 5 years or more. In more recently settled areas households have been selling for a shorter time.

Almost no-one plans to build more water tanks, as they rarely have space for more tanks. Half of tank-owners envisage still selling water in 5 years time. A slightly higher percentage of those who are supplied by tanker-lorry (60%) envisage still selling water in 5 years time and are less optimistic that their area will have a good supply of piped water then.

5.4 Other informal water sector actors

5.4.1 Roboteiros

Roboteiros (porters) carry water to the houses of clients in containers of 20 liters (from standpipes or neighbour's taps or tanks). For each container a porter charges about 50 Kwanzas in addition to the fee for the water from the source. This is a considerable fee and indicates the true value of the time spent by women and children queuing for water and carrying it.

5.4.2 Street Vendors:

These are vendors who sell water in small containers in the street or in market places. These usually sell in units of half a litre for either 5 or 10 Kwanzas. This is again a considerable mark-up, which comes from the value of drinking water in the right place to customers when they are working or travelling.

5.4.3 ANGOMENHA

ANGOMENHA (Associação de Captadores e Tranportadores de Água) is a union which interacts with the government and EPAL on behalf of the truck drivers and water pump owners who constitute the informal water sector in Luanda. The headquarters of the Association are located at Kifangondo, as the majority of its members operate from this site.

5.4.4 Water Pump Owners

The pumps at the Kifangondo *girafas* are privately owned. The owners receive payment for the service from the drivers. Each pump earns 100 to 150 US Dollars per day, and payment is 70 Kwanzas for every cubic metre of water. The price of pumping the water at this location is thus higher than the official EPAL industrial tariff for water.

Each pump has about four workers who operate it during the day and as a form of payment these workers keep the pump's total profits for one day of each week of operation (split amongst the four of them).

The costs of owning and operating the pump are high with each pump and motor costing about 10,000 to 12,000 US Dollars. The *girafa* tubing itself costs about USD 6,000 making the start-up

costs of a pump owner over USD 20,000. In addition, they must pay for upkeep of the equipment as well as gasoline (about 60 L per day).

Each pump owner and truck driver is also expected to pay fees to ANGOMENHA and the Government including a 1% monthly tax on revenues paid to the Ministry of Finance. There is thus a link between the informal market for water at Kifangondo and the formal market system of taxation. The other fees are for the union costs as well as maintenance of the road leading to the *girafas.*

5.4.5 DNA Chlorine Treatment (Kifangondo)

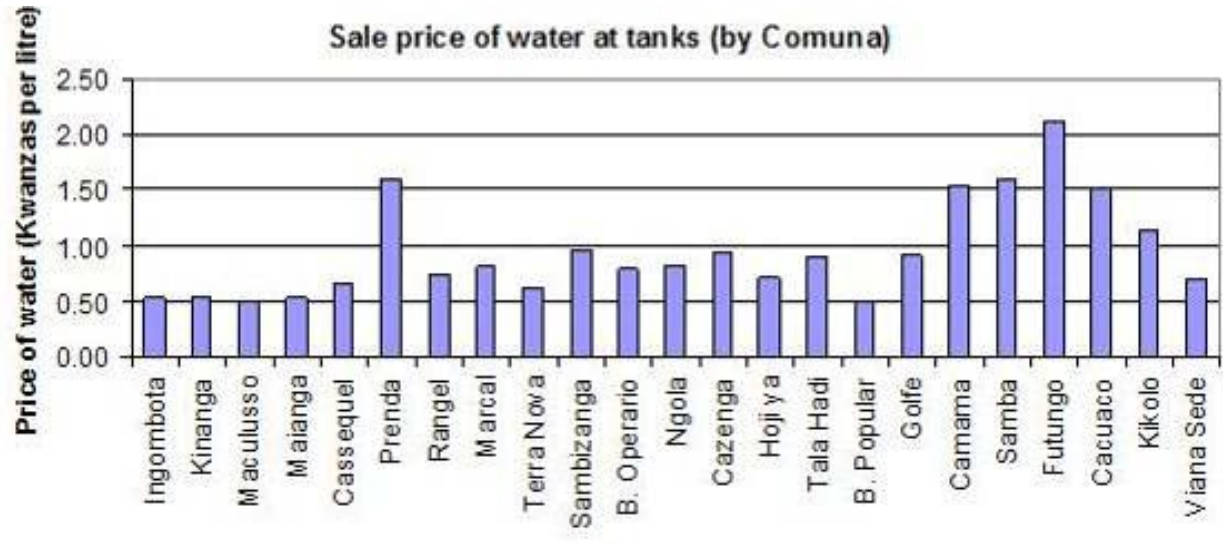
Water from the River Bengo is untreated. Each tanker-lorry that leaves Kifangondo is required to stop at a small station where the drivers pay Kwz 10 (USD .12) for every $1m^3$ of water to be treated in their cisterns.

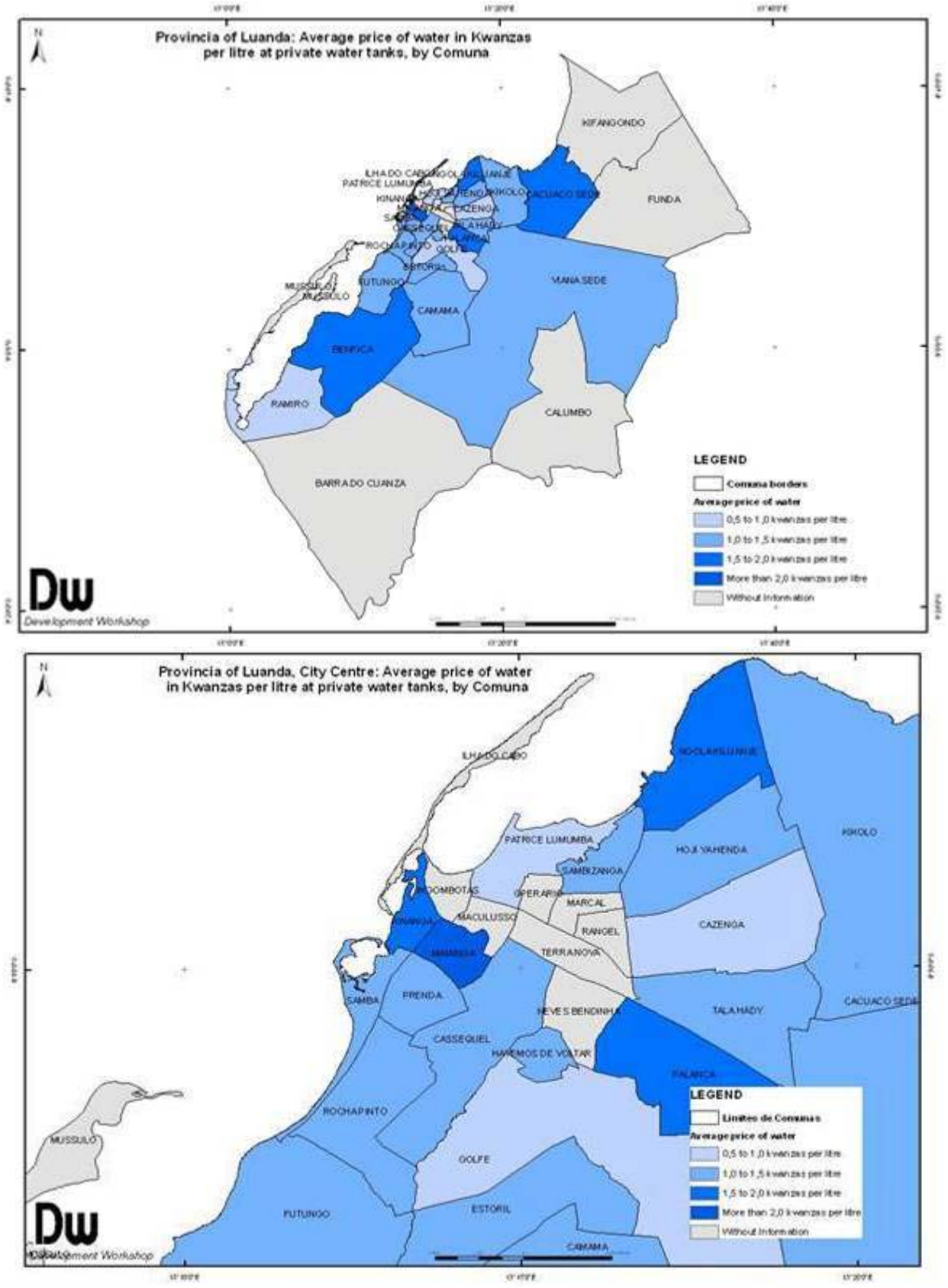
There is no system to verify that the water has successfully been treated (most of the time no one actually watches or records the drivers putting the chlorine into the tank), although weekly samples of water are taken to the EPAL laboratory where they analyze the level of chlorine in the sample.

6 Price of water to the consumer

In 1995 it was found that the price of water to the consumer varied between 1.21 and 16.90 US Dollars per cubic meter. The highest prices were in Rocha Pinto (16.91 USD), Palanca (14.30 USD), Tala Hadi (12.27 USD) and Golfe (12.73 USD). It was found that price was influenced by the source of water (whether it was from the piped distribution network or from tanker-lorries). In neighbourhoods where the primary source of water was tanker-lorries, the price depended on the distance from the River Bengo, the major source of trucked water at that time.

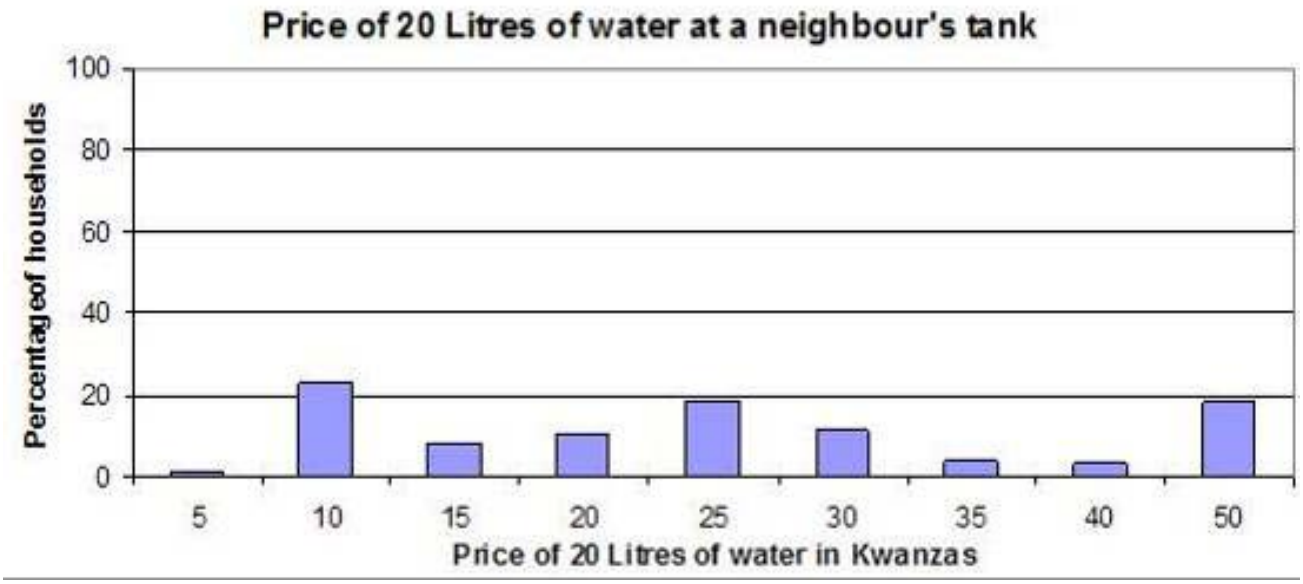
Today, the average selling price at water tanks is 11.47 US Dollars per cubic metre according to the owners of tanks and 16.80 US Dollars per cubic metre according to the purchasers of water. The average price of water from tanks is therefore probably now the same as the highest price in the mid-1990s.

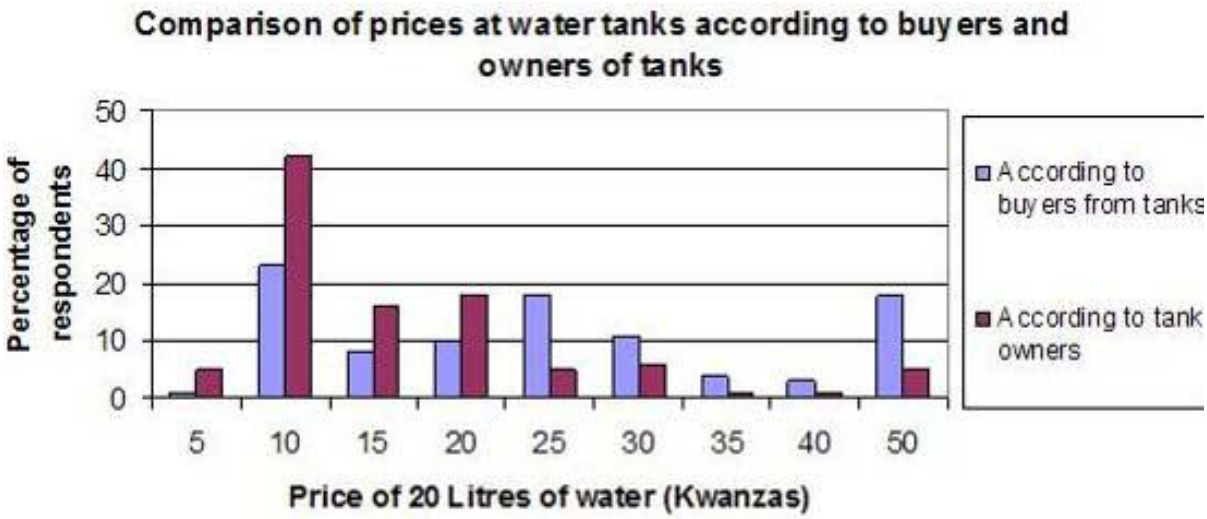




The price of water from neighbour's tanks is still influenced by whether the source of water to the tank is from the piped distribution network or from tanker-lorries, and by the distance from the primary source of water. However the *girafas* at Kifangondo are no longer the only source of water for tanker-lorries so the price does not depend to such an extent on the distance from this point. Prices are highest in parts of the Comuna of Samba which are distant from piped water and from any of the *girafas,* and the price of water can increase over short distances.

The prices reported by users are higher than those reported by owners of water tanks.

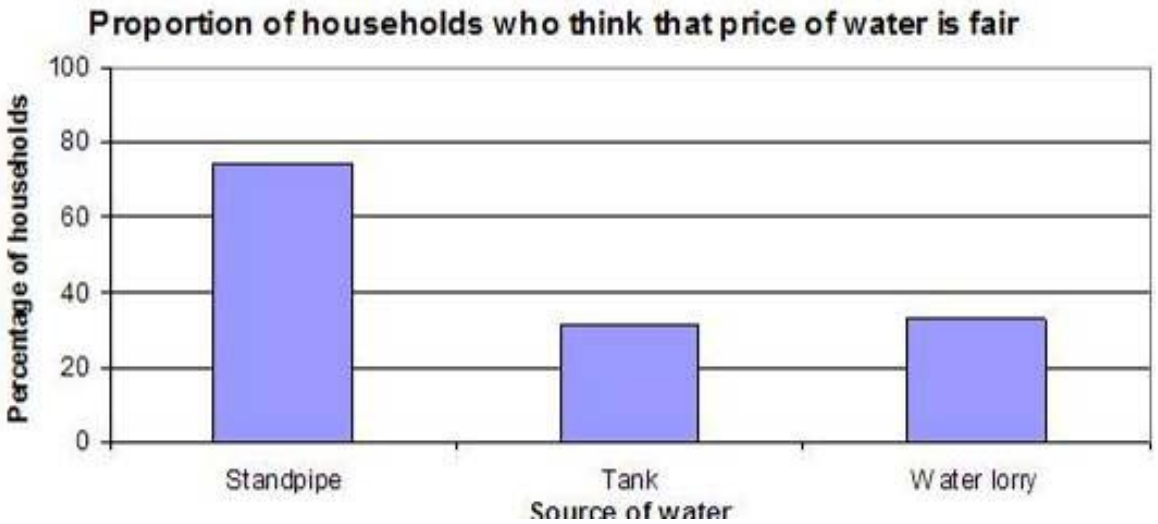




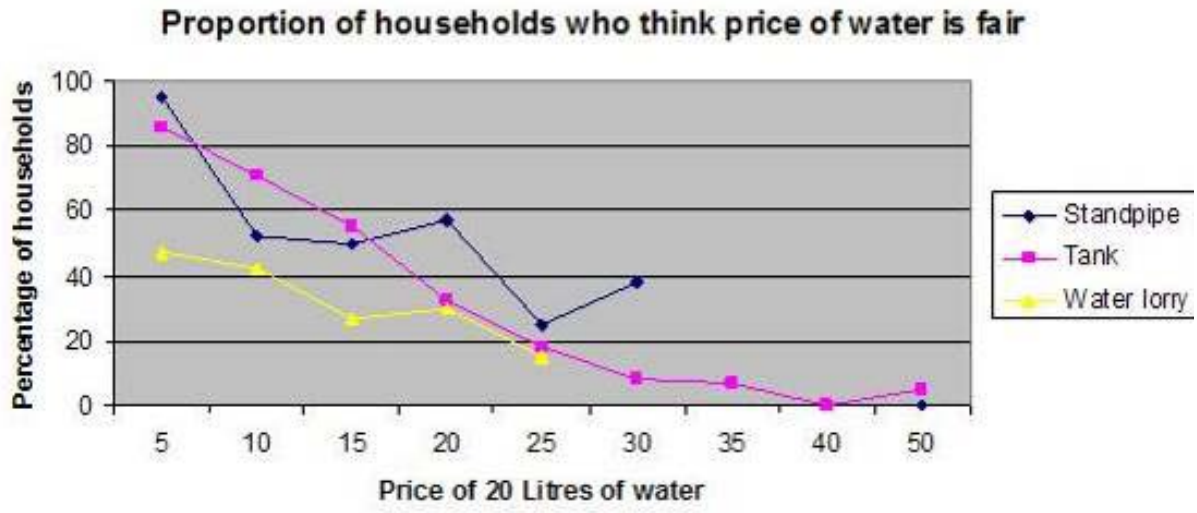
The average water consumption is reported as slightly less than 20 litres per person per day. An average household of 6 people will thus consume 120 litres per day, or 3,600 litres per month. If they pay 20 Kwanzas for 20 litres of water, the household is spending 3,600 Kwanzas per month for water. The average household reports (in this survey and in other DW surveys) that their mean monthly expenditure is about 22,500 Kwanzas. This is possibly an underestimate, as people live by the day household income and expenditure varies greatly between days: it is likely that households do not remember all their income and expenditure and do not take account of the unexpected income from odd-jobs or unexpected sales of goods in the informal market. Even if the average monthly household is higher, at about 36,000 Kwanzas, it means that there are a significant number of families who are spending 10% of their household budget on water. It is almost certainly true that a high proportion of households are spending much more than 5% of their household budget on water.

A high proportion of households think that the price that they are paying for water is unfair. The proportion of households who think that the price that they are paying for water is unfair depends to some extent on the source of water. Almost all households who have piped water

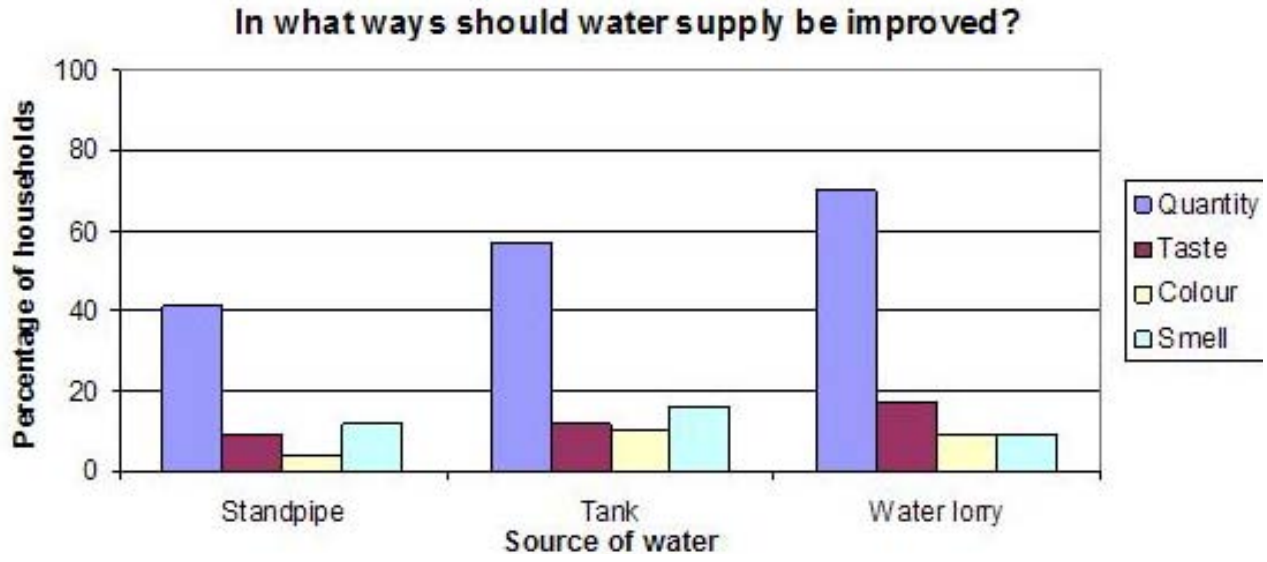
think that the price is fair, as do three-quarters of households who obtain water from a standpipe: many of them are not paying anything and the rest are paying 5 Kwanzas or 10 Kwanzas for 20 litres of water. Only about 30% of those obtaining water directly from tanker-lorries or from neighbours' tanks think that the price is fair, as the price is frequently 20 Kwanzas or more for a 20 litre container of water.

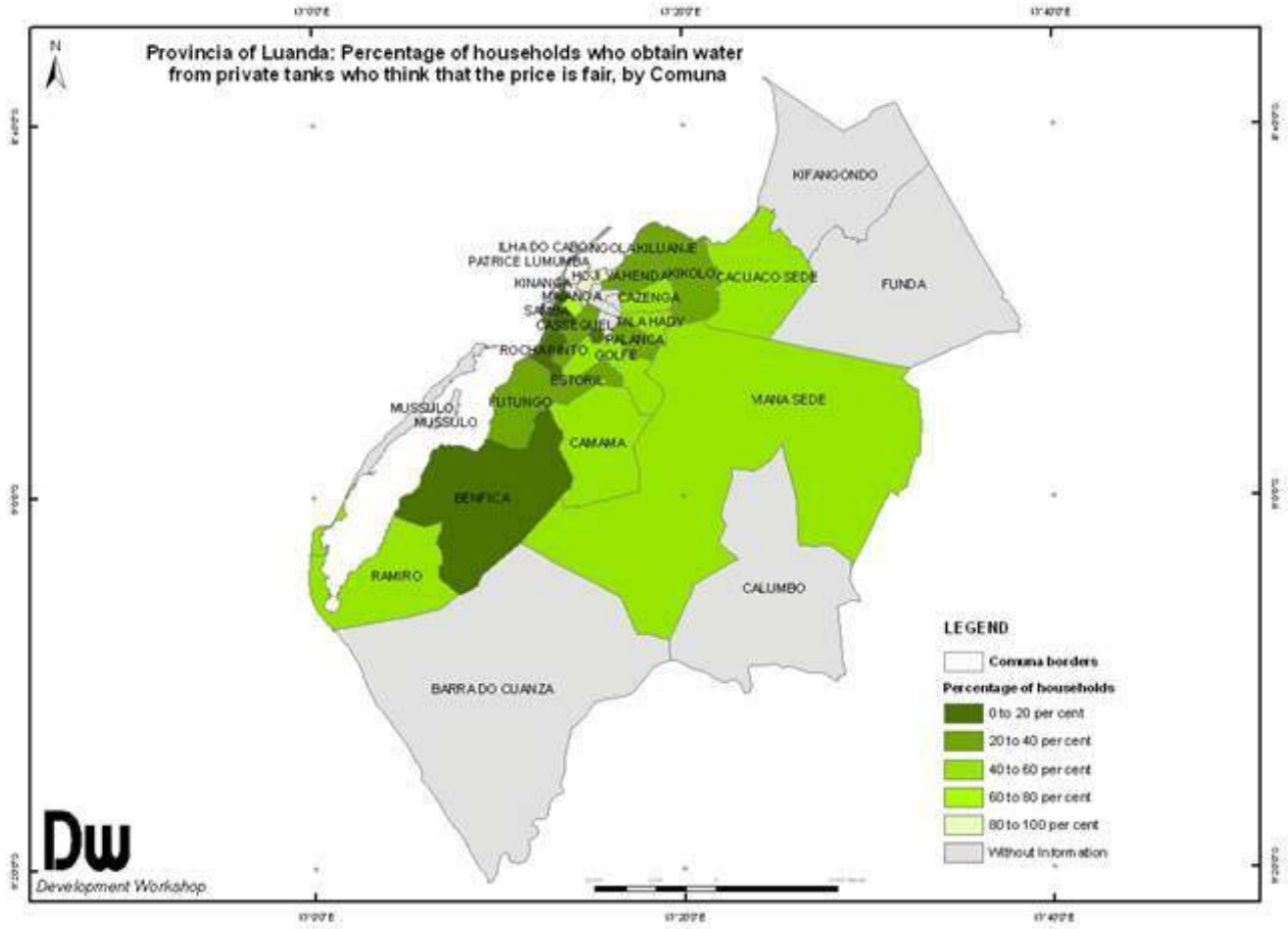


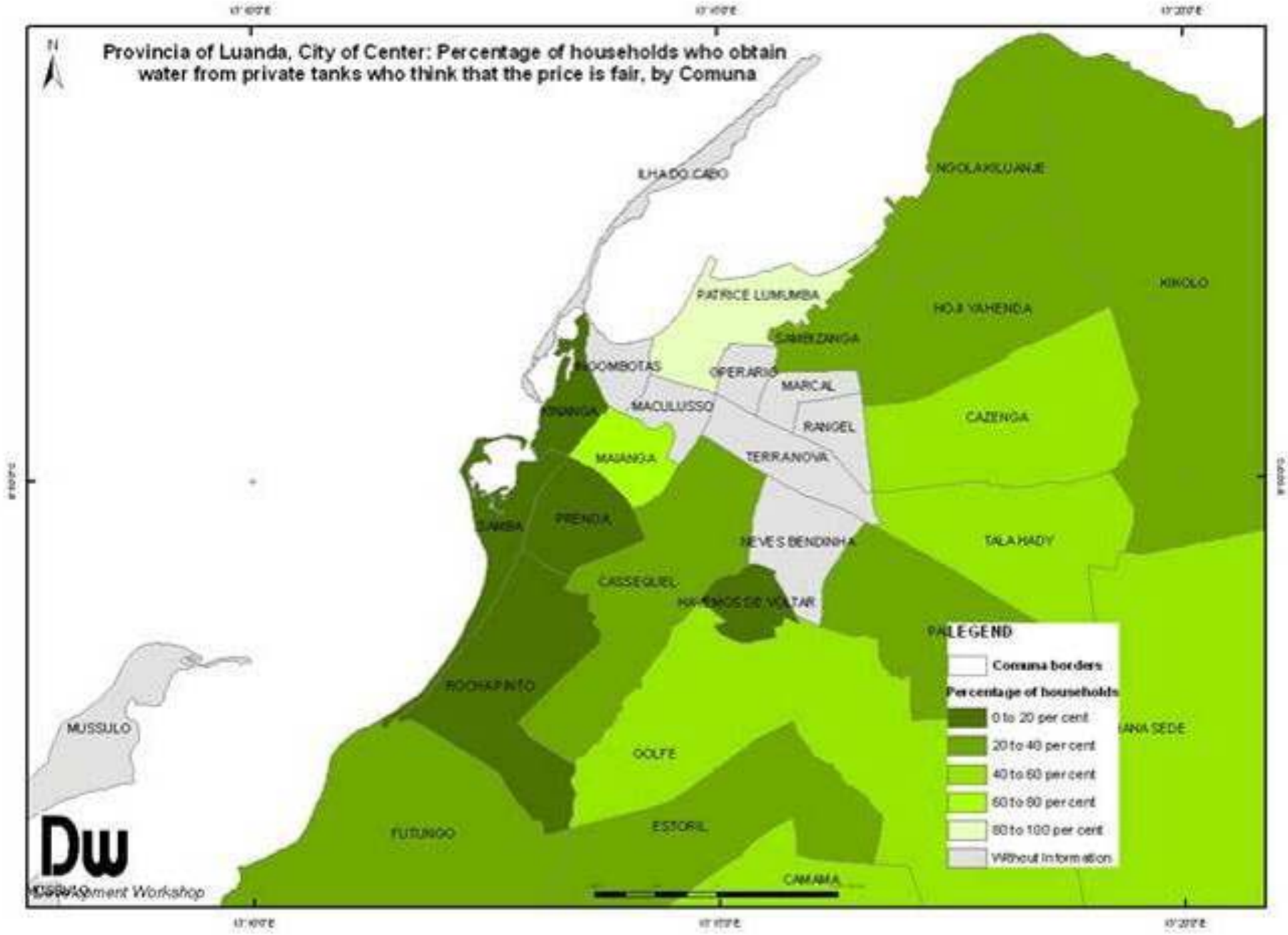
Satisfaction with the price declines as the price increases, irrespective of the water source. The majority of households who get water from neighbours' tanks are dissatisfied with the price when it is 20 Kwanzas or more for a 20 litre container of water, but only 30% are dissatisfied when the price is 10 Kwanzas for a 20 litre container of water. The price paid for water by consumers at water tanks can vary over quite short distances. For example in the area of a Development Workshop project in parts of the Comunas of Kikolo and Hoji ya Henda, 87% of households obtain water from a neighbour's water tank and there are no significant differences between *bairros*: in all *bairros* more than 80% of households use a neighbour's water tank as the main source of water and an insignificant number of households have piped water. Overall 72% of households report that the price of a 20 litre container of water at a water tank is more than 20 Kwanzas. However, in Kikolo Sede and Boa Esperança significantly fewer households report a price of more than 20 Kwanzas for 20 litres than in the other *bairros*. This difference is not due to any difference in the source of supply of water to the tanks but due to the distance of bairros from the primary water source and the condition of roads.



Two thirds of households who obtain water from a standpipe mention a way in which water supply should be improved, while everyone who obtains water from a tank or directly from a water lorry mentions a way in which water supply should be improved. The quantity of water available is the main improvement sought by respondents and in all cases this outweighs all concerns about the quality of water.



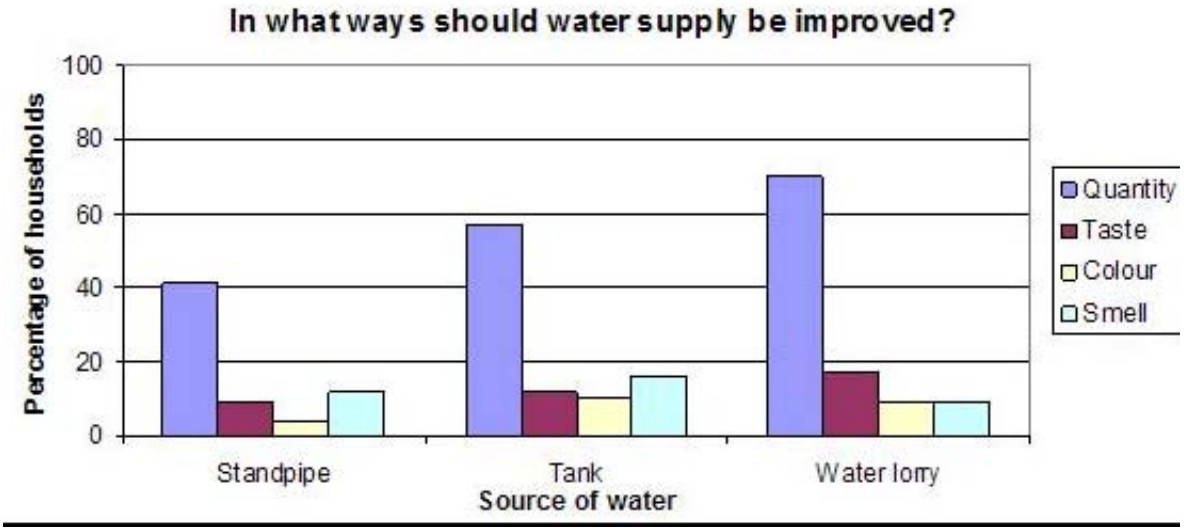



Provincia of Luanda, City of Center: Percentage of households who obtain water from private tanks who think that the price is fair, by Comuna
ILHA DO CABO
PATRICE LUMUMBA
NGOLA KILUANJE
KIKOLO
HOJI YA HENDA
SAMBIZANGA
OPERARIOS
MARCAL
MACULUSSO
RANGEL
CAZENGA
TERRANOVA
MAIANGA
PRENDA
NEVES BENDINHA
TALA HADY
CASSEQUEL
ROCHA PINTO
MUSSULO
GOLFE
FUTUNGO
ESTORIL
CAMAMA
LEGEND
Comuna borders
Percentage of households
0 to 20 per cent
20 to 40 per cent
40 to 60 per cent
60 to 80 per cent
80 to 100 per cent
Without information
Dw
Development Workshop

7 Conclusions and recommendations

The majority of households in peri-urban Luanda obtain water through the informal peri-urban water market. The turn-over in this market is probably more than 250 Million US Dollars per year. The supply chain mainly involves tanker-lorries and household water tanks and the price of water rises considerably in the supply chain to levels that many consumers consider unfair, and which limit their consumption. The supply chain brings the product to the consumer, at a considerable cost, but does not add any other value to the product (and the quality may deteriorate along the chain). The use of tanker-lorries in the supply chain pushes up the cost of water to levels at which households reduce consumption and are spending much more than the 5% of household budget which is the international norm.

Almost all those who are supplied by water from a tank or directly from a tanker-lorry are looking for improvements on their supply of water, usually in the quantity of water rather than in the quality. Fewer households who are supplied with water by standpipe are seeking improvements.



At present supply of water in Luanda is not meeting demand and the poor continue to receive least water and pay the most. Improvements are presently being made to the water supply system of Luanda but it is important that these efforts are stepped up and focused on areas where the quantity of water being supplied is lowest and the prices are highest. It is important that the piped water system continues to be expanded. Improvements through standpipe projects provide more rapid improvements than piped water to each dwelling. A realistic strategy would be to expand water supply to unserved areas through standpipe projects, as this is a relatively rapid way of increasing supply and reducing the price to levels that households think are fair. Piped supply to individual dwellings could follow later, after overall coverage (by standpipes) has been considerably improved. Piped supply to individual dwelling should also wait until drainage has been improved.

It is important that there are projects to improve water supply to particular areas through standpipes, Standpipe projects should give priority to the worst-served areas and households in those areas. There has been a tendency for projects to reduce the areas that they serve, improving supply to households closest to the main pipelines (and thus paying least for water) and not improving conditions for households who are worst served.

There is generally a willingness to pay 5 Kwanzas for 20 litres of water at standpipes, as this is considerably less than the price paid for water from the informal sector. By default this tends to become the price when attempts are made to introduce complex systems to introduce a lower price. Local organisations such as ACAS can ensure that the money is used to maintain the service (through maintenance, and paying a monitor) and to improve other local services if there

is a surplus. It removes the cost of maintaining the standpipes from EPAL and provides more funds for improvements to the service.

It is however possible that there will continue to be significant areas supplied from the informal peri-urban water sector for several years, especially if the city continues to expand as fast as it has done in recent years. The long-term aim must be to ensure that formal sector expands to the whole city but recognise that the informal market will continue to play a role for some time and informal sector actors should be part of the short-term strategy. It is therefore important that EPAL facilitates the operation of the informal water economy and recognises that the principal actors in the informal water economy play an important role in providing a basic social need.

The following points include solutions which aim to improve access to water, particularly for those who currently do not have good access to it::

- Bairros with very low access to piped water should be identified along with owners of tanker-lorries willing to serve these bairros, and ways identified through which they can be assisted

- The time that tanker-lorries wait to fill up should be reduced, by improving conditions and flow at the girafas, as well as supplying more girafas could have a significant impact on the amount of water available and reduce prices. The supply of water to tanker-lorries could be improved by increasing the supply at each *girafa* (for example by improving electricity supply to the pumps and keeping the pipes in good repair), improving access conditions at each *girafa* (improving drainage and access and regularly mending the road surface) and by increasing the number of *girafa*s at points accessible to the areas of the city with poor water supply.

- There should be better control of the chlorination of water in tanker-lorries leaving Kifangondo, and households who sell water from tanks should be encouraged to chlorinate the water that they sell. Water supplied from the *girafas* at Kifangondo is untreated. It is likely that the quality of water supplied by tanker-lorries from other points is also poor because of being transported in tanks and the amount of handling that takes place. It is recommended that more should be done to encourage chlorination of water in tanker-lorries and from tanks.

- Efforts should be made to reach agreements between the police and representatives of lorry owners and drivers, so as to reduce the time lost due to lack of papers and the money spent on fines (which appears to be a significant part of the their outgoings)

- EPAL should increase efforts to enforce payment for the water that it produces so as to be able to better maintain and expand the formal water supply system. In the informal water supply sector, two-thirds of households are willing to pay 10 Kwanzas for 20 litres of water. Households whose payment for piped water is not being enforced are being charged significantly less. It is quite justifiable to enforce payment for piped water in these circumstances. If it is too costly to repair or install water meters for piped water, flat-rate tariffs could be introduced.

- EPAL should charge, at their standpipes, the price that users are willing to pay, which at present is about 5 Kwanzas for 20 litres. There is a significant amount of money circulating in the informal water market and capturing some of this could help to pay for improvements in the water supply system. With the present undeveloped state of the formal water system in Luanda, more public benefit can be achieved by increasing the amount of money available for investment in improving the system than by providing cheap or free water. The present policy of charging a very small amount at standpipes reduces the investment funds that EPAL has available, slows down the spread of formal

water supply and increases inequity between those with and without formal water supply.

- EPAL should make more efforts to reduce losses of water in the system, either through leaks or unauthorised extraction, as these losses are high and represent